Agilent Technologies

Agilent Technologies 85325A R/Q/U/V/W Millimeter Subsystem

Agilent Technologies 85326A Millimeter-Wave Interface Kit

Operating and Service Manual

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Chapter 1 • Installation

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Chapter 3 • General Information

Chapter 4 • Performance Verification

Chapter 5 • Timebase Check and Adjustment

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Appendix A • Using the HP 8340/41 in Your System

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`http://www.agilent-tech.com/services/English/index.html`

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Review this product and related documentation to familiarize yourself with safety markings and instructions before you operate the instrument. This product has been designed and tested in accordance with international standards.

WARNING

The WARNING notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

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The **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

Instrument Markings

	When you see this symbol on your instrument, you should refer to the instrument's instruction manual for important information.
	This symbol indicates hazardous voltages.
	The laser radiation symbol is marked on products that have a laser output.
	This symbol indicates that the instrument requires alternating current (ac) input.
	The CE mark is a registered trademark of the European Community. If it is accompanied by a year, it indicates the year the design was proven.
	The CSA mark is a registered trademark of the Canadian Standards Association.
1SM1-A	This text indicates that the instrument is an Industrial Scientific and Medical Group 1 Class A product (CISPER 11, Clause 4).
	This symbol indicates that the power line switch is ON.
	This symbol indicates that the power line switch is OFF or in STANDBY position.

Safety Earth Ground

This is a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and secured against any unintended operation.

Before Applying Power

Verify that the product is configured to match the available main power source as described in the input power configuration instructions in this manual. If this product is to be powered by autotransformer, make sure the common terminal is connected to the neutral (grounded) side of the ac power supply.

Declaration of Conformity

This is to certify that this product meets the radio frequency interference requirements of Directive FTZ 1046/1984. The German Bundespost has been notified that this equipment was put into circulation and has been granted the right to check the product type for compliance with these requirements.

If test and measurement equipment is operated with unshielded cables and/or used for measurements on open set-ups, the user must insure that under these operating conditions, the radio frequency interference limits are met at the border of his premises.

Model Agilent 85325A and Model Agilent 85326A

Hiermit wird bescheinigt, dass dieses Gert/System in bereinstimmung mit den Bestimmungen von Postverfgung 1046/84 funkentst"rt ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gertes/Systems angezeight und die Berechtigung zur berprfung der Serie auf Einhaltung der Bestimmungen eingerumt.

Zustzinformation fr Mess-und Testgerte:

Werden Mess- und Testgerte mit ungeschirmten Kabeln und/oder in offenen Messaufbauten verwendet, so ist vom Betreiber sicherzustellen, dass die Funk-Entst"rbestimmungen unter Betriebsbedingungen an seiner Grund-stcksgrenze eingehalten werden.

Typeface Conventions

Italics

- Used to emphasize important information:
  Use this software *only* with the Agilent 00000X.
- Used for the title of a publication:
  Refer to the *Agilent 85325A Operating and Service Manual*.
- Used to indicate a variable:
  Type `LOAD BIN` *filename*.

`Instrument Display`

- Used to show on-screen prompts and messages that you will see on the display of an instrument:
  The Agilent 00000X will display the message **`CAL1 SAVED`**.

[Keycap]

- Used for labeled keys on the front panel of an instrument or on a computer keyboard:
  Press **[Return]**.

{Softkey}

- Used for simulated keys that appear on an instrument display:
  Press ***{Prior Menu}***.

`User Entry`

- Used to indicate text that you will enter using the computer keyboard; text shown in this typeface must be typed *exactly* as printed:
  Type `LOAD PARMFILE`
- Used for examples of programming code:

```
#endif // ifndef NO_CLASS
```

`Path Name`

- Used for a subdirectory name or file path:
  Edit the file *`usr/local/bin/sample.txt`*

Computer Display

- Used to show messages, prompts, and window labels that appear on a computer monitor:
  The **Edit Parameters** window will appear on the screen.
- Used for menus, lists, dialog boxes, and button boxes on a computer monitor from which you make selections using the mouse or keyboard:
  Double-click **EXIT** to quit the program.

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1 Installation

This chapter explains how to:

- set up the equipment
- adjust LO power levels
- check mixer operation
- perform final installation

WARNING

This equipment is capable of radiating millimeter-wave energy from the end of an unterminated waveguide. Do not look directly into the open end of any waveguide when it is connected to a source of millimeter-wave energy.

Take precautions consistent with ANSI C95.1 - 1982, a study performed by the American National Standards Institute that sets limits for human exposure to microwave and millimeter-wave energy. Copies of this publication are available from:

American National Standards Institute
11 West 42 Street
New York, New York 10036
Telephone: (212) 642-4900
WEB site: www.ansi.org

CAUTION

Do not connect LO power to the HP/Agilent 11970 mixers until you adjust the LO power in “Mixer LO Power Level Adjustment” on page 1-8. If you connect LO power before adjusting it you could permanently damage the mixers.

Required Equipment

The following equipment is required when performing installation.

Table 1-1 Equipment Required

Item	Qty	HP/Agilent Model or Part Number
Power Meter	1	HP/Agilent 436, 437, 438, E4418, or E4419
Power Sensor	1	HP/Agilent 8485A, 8487A or 8481A
5/16 inch Wrench	1	08555-20097 (supplied with Agilent 85326A)
T-10 Torx Driver	1	8710-1623 (supplied with Agilent 85326A)
1/4 inch Wrench	1	8710-0510 (supplied with Agilent 85325A)
3/16 inch Wrench	1	8710-0013 (supplied with Agilent 85325A)
3/32 Hex Ball Driver	1	8710-1539 (supplied with Agilent 85325A)
Adapter, 3.5 mm (f) to (f)	1	1250-1749

Initial Setup

Connect the equipment as shown in Figure 1-1.

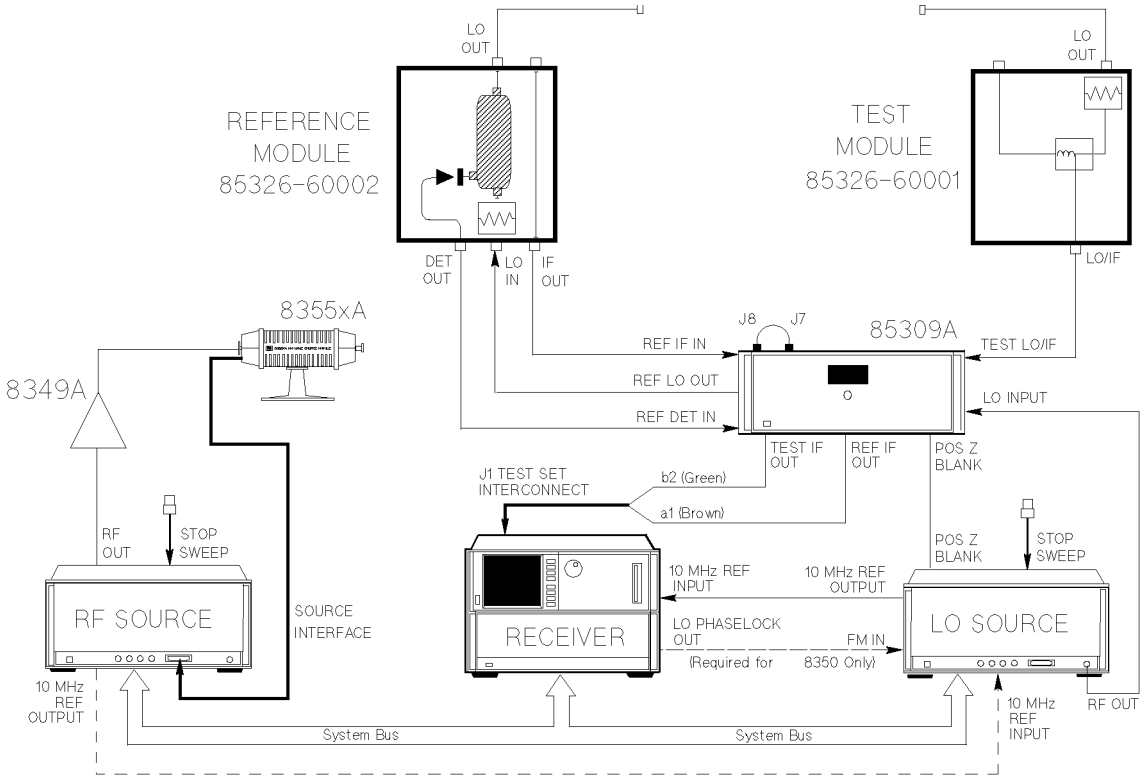

Figure 1-1 Initial Setup

NOTE

It is important that you connect the mm-wave head to the RF source (as shown in Figure 1-1) before using the procedures in this manual. The mm-wave head configures the RF source so it will accept mm-wave band start and stop frequency commands from the receiver.

Using an HP/Agilent 8340/41 RF Source

If you are using an HP/Agilent 8340/41 as an RF source, refer to Appendix A for setup information.

Connecting the Waveguide

When connecting the waveguide, refer to Appendix B, “Connecting the Waveguide Properly.” Use the waveguide accessory hardware kit when connecting the waveguide components.

10 MHz Reference Connection

The 10 MHz reference connection (see Figure 1-1 on page 1-3) between the RF and LO sources locks the signal frequency of the two sources together.

When the sources are separated by a long distance, make sure the 10 MHz signal is *at least -17 dBm or greater at the 10 MHz REF INPUT.* The 10 MHz REF OUTPUT produces 0 dBm.

Checking the Signal

You can check to see if a 10 MHz signal is reaching the destination source as follows:

NOTE This procedure assumes at least one source has a front panel.

Procedure

1. Set up the sources so that they are ***not*** under HP/Agilent 8530 control.
2. Connect the 10 MHz cable between the LO and RF source 10 MHz REF jacks. Make sure you use the 10 MHz REF IN on the source with a front panel. (This will be called the *receiving unit.*)
3. Preset the sources.
4. If **EXT REF** is displayed on the bottom-left of the receiving units display, the signal is satisfactory.

Receiver Settings

NOTE

[Brackets] indicate a front-panel key or on a computer key board.
{Braces} indicate a display softkey selection.

Setting Up the Receiver

1. Turn ON the RF source. Make sure it is set to GPIB address 19.
2. Turn ON the LO source. Make sure it is set to GPIB address 18.
3. Turn ON the following components in the order shown:
   a. RF power amplifier (if used)
   b. HP/Agilent 85309A
   c. Receiver

NOTE

If your LO source is an HP/Agilent 8350, it is normal for

`CAUTION, NO IF FOUND` or

`CAUTION: SOURCE 1 FAILURE  RF UNLOCKED`

to appear on the screen at this time. The message will go away later, when you connect the reference mixer.

4. Press:

   [USER PRESET]

   [SYSTEM]

   {GPIB ADDRESSES}

   {SOURCE #2} **[1][8] [x1]** (sets address of the LO source)

5. If using an HP/Agilent 8510, press: ***{TEST SET}*** **[3][1] [x1]**
6. If using an HP/Agilent 8530, press: ***{CONVERTER} {SET ADDRESS}*** **[3][1] [x1]**

   Press:

   [RECALL] ***{MORE} {FACTORY PRESET}***

   Press:

   [SYSTEM] ***{MORE} {SYSTEM PHASELOCK}***

   a. If using a synthesized LO, select ***{LOCK TYPE: NONE}***.
   b. If using an HP/Agilent 8350 source, select ***{LOCK TYPE: EXTERNAL}***.

7. Press:

   [PRIOR MENU]

   {POWER LEVELING}

   {SOURCE 1: MM MODULE LEVELING}

NOTE I

In some setups, ***{SOURCE 1: MM MODULE LEVELING}*** is not appropriate. Select ***{SOURCE 1: INTERNAL}*** if:

- Using an HP/Agilent 8510B
- Using an HP/Agilent 8510C with firmware Revision 6.1 or lower.
- The source interface cable is *not* connected to the HP/Agilent 836xx.
- Using an HP/Agilent 8340/41, and it is *not* connected as shown in Appendix A.

8. Press:

   {SOURCE 2: INTERNAL}

   [PRIOR MENU]

   {EDIT MULT. SRC.}

9. Press:

   {DEFINE: SOURCE #1}

   {MULTIPLIER NUMER.} **[1] [x1]**

10. Press ***{MULTIPLIER DENOM.}*** and do one of the following:

    a. If source 1 (the RF source) is an HP/Agilent 836xx, and the source interface cable *is* connected: press **[1] [x1]**

    b. If source 1 is an HP/Agilent 836xx and the source interface cable *is not* connected, enter the DENOM value for your band (shown in Table 1-2), remember to terminate with **[x1]**.

Table 1-2 Rf Source DENOM Value Table

Band	DENOM Value	Start Freq (GHz)	Stop Freq (GHz)
R	2	26.5	40
Q	3	33	50
U	3	40	60
V	4	50	75
W	6	75	110

c. If source 1 is an HP/Agilent 8340/41, enter the DENOM value (in Table 1-2 on page 1-6) for your band. Terminate with **[x1]**.

11. Press:

    {OFFSET FREQUENCY} **[0] [x1]**

    {DONE}

12. Press:

    {DEFINE: SOURCE #2}

    {MULTIPLIER NUMER.} **[1] [x1]**

13. Press ***{MULTIPLIER DENOM.}***, and enter the value (shown in Table 1-3), remember to terminate with **[x1]**:

Table 1-3 Lo Source Multiplier DENOM Table

Band	DENOM Value	Start Freq (GHz)	Stop Freq (GHz)
R	8	26.5	40
Q	10	33	50
U	10	40	60
V	14	50	75
W	18	75	110

14. Press:

    {OFFSET FREQUENCY} **[2][0] [MHz]**

    {DONE}

15. Press: ***{RECEIVER}{CONSTANT FREQUENCY}*** **[2][0] [MHz]**

16. Press: ***{DONE} {MULT. SRC: ON / SAVE}***

17. Press STIMULUS **[MENU]** ***{POWER MENU}***

    {POWER SOURCE 1} **[0] [x1]**

    {POWER SOURCE 2} **[1][0] [x1]**

    [PRIOR MENU] ***{STEP}***

18. Enter the start and stop frequencies using the **[START]** and **[STOP]** keys. Use the start/stop frequencies shown in Table 1-2 for your specific mixer.

Mixer LO Power Level Adjustment

NOTE

[Brackets] indicate a front-panel key or a computer key board.
{Braces} indicate a display softkey selection.

CAUTION

It is critical that you set LO power before connecting the HP/Agilent 11970 mixers.

Initial Setup

1. If using an HP/Agilent 8530A, press:

   [DOMAIN] ***{FREQUENCY}***

2. Place the receiver in the single point (CW) mode by pressing:

   STIMULUS **[MENU]**, ***{SINGLE POINT}***.

3. Press **[CENTER]** and enter the lowest frequency available in your millimeter band.

Initial Fixed Attenuator Value Selections

The internal fixed attenuator value in the reference module is set so the mixer LO input port is not damaged by excessive power (maximum power for an HP/Agilent 11970x is +20 dB). The maximum unleveled power is possible if the ALC loop of the HP/Agilent 85309A and reference module is broken.

To check what the maximum unleveled power level is:

1. Disconnect the detector voltage feedback cable at the reference module while monitoring the power level as shown in Figure 1-4 on page 1-11. Perform the test within the frequency range of operation.
2. Install an attenuator in the reference module which has a value that keeps the power level below your mixers damage level. (See Figure 1-2 on page 1-10.)

NOTE

The attenuator values shown in Table 1-4 on page 1-9 can be used if HP/Agilent 85381A RF cable assemblies are used.

3. Determine the minimum attenuator value for the 85326-60001 (test module), and the 85326-60002 (reference module) using Table 1-4 on page 1-9.

Table 1-4 Selecting Agilent 85326A Reference and Test Attenuation

Length of LO Cable from HP/Agilent 85309A[1] to Reference Module[2] (L_V Cable)	Reference Module Attenuation Required	Test Module Attenuation Required
9 meters	0 dB	0 dB
8 meters	1 dB	0 dB
7 meters	1 dB	1 dB
6 meters	2 dB	1 dB
5 meters	2 dB	2 dB
4 meters	3 dB	2 dB
1.5 to 3 meters	3 dB	3 dB

1. Assumes use of HP/Agilent 85381A cable type.

2. A standard Agilent 85325A system uses 8, 6, or 4 meter cables.

How to Use the Chart

Determine the length of the LO cable that goes from the HP/Agilent 85309A REF LO OUT connector to the reference module's LO IN connector.

Look the length up in Table 1-4 to find the appropriate amount of attenuation for the test and reference modules.

HP/Agilent cables have label sleeves marked *C04*, *C06*, or *C08*. The number represents the length of the cable in meters. Standard systems use LO cables that are 4, 6, or 8 meters in length. Other lengths are not standard but might apply to special systems.

Changing Attenuation

Procedure

1. Use the supplied #10 TORX driver to remove the screws securing the module covers.
2. Observe the attenuator that is connected to the reformable cable. Hold the body of this attenuator in place with one of the supplied 5/16 inch wrenches.
3. Use the other 5/16 inch wrench to disconnect the reformable cable.
4. Remove other attenuators, as required, using this method.
5. Place unused attenuators in the holders (see Figure 1-2 and Figure 1-3 on page 1-10.)
6. Replace the reformable cable.

7. Make sure the connections inside the module are secure before replacing the module covers (8 to 10 in-lbs of torque is recommended).
8. Replace the module covers and screws. Tighten the screws until they are snug. *Do not over-tighten.*

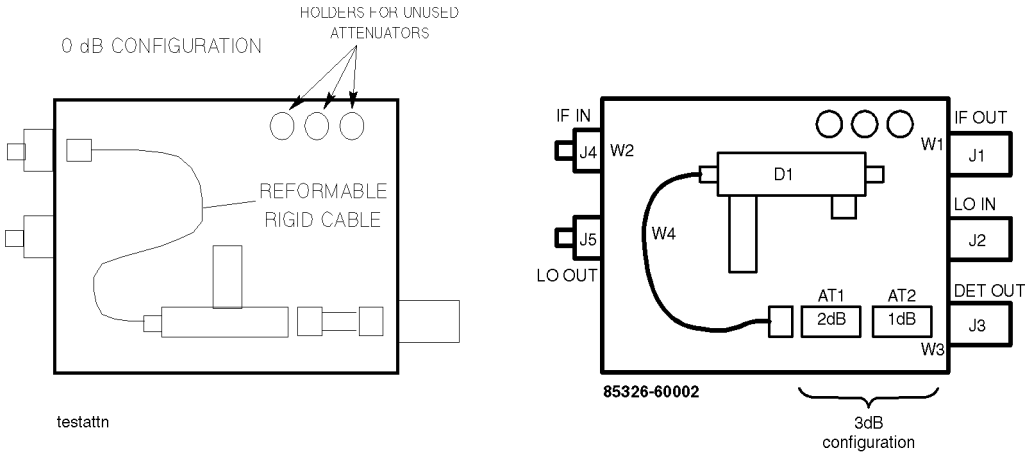

Figure 1-2 Reference Attenuator Installation

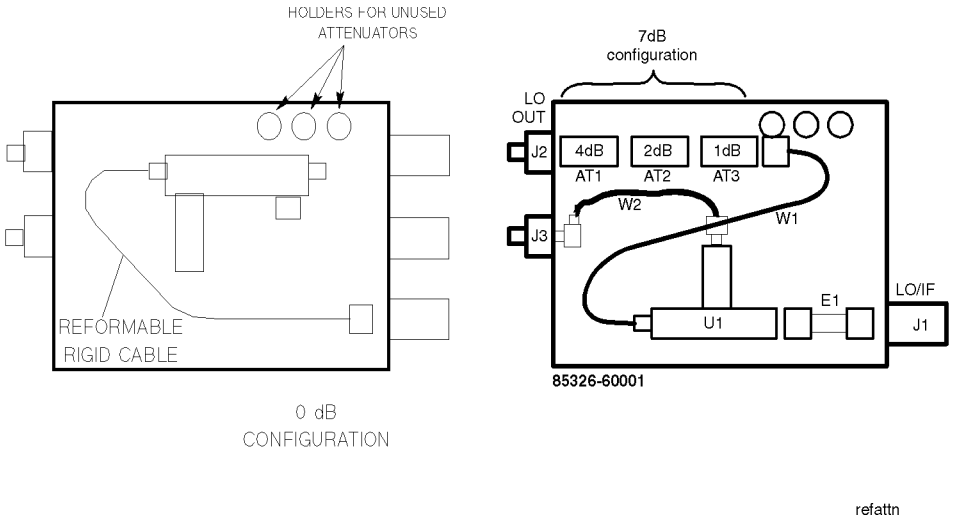

Figure 1-3 Test Attenuator Installation

Adjustment Procedures

NOTE

[Brackets] indicate a front-panel key on a computer keyboard.
{Braces} indicate a display softkey selection.

LO power must be adjusted before connecting the Agilent 85325A mixers to avoid damaging them. Use Procedure 1 or 2, as appropriate:

- Procedure 1
  Use this procedure if you are only going to use the Agilent 85325A/Agilent 85325A mixer configuration.
- Procedure 2
  Use this procedure if you are going to reconfigure your system between Agilent 85325A/Agilent 85326A mixers and other mixer types. Procedure 2 eliminates the need to readjust LO power when switching between the Agilent 85325A and other mixers.

Procedure 1

This procedure applies to systems that only use Agilent 85325A mixers.

Initial Setup

1. Zero and calibrate the power meter (refer to your power meter manual).
2. Determine the power sensor calibration factor at 4 GHz, and set the power meter accordingly.
3. Connect the power meter as shown in Figure 1-4.

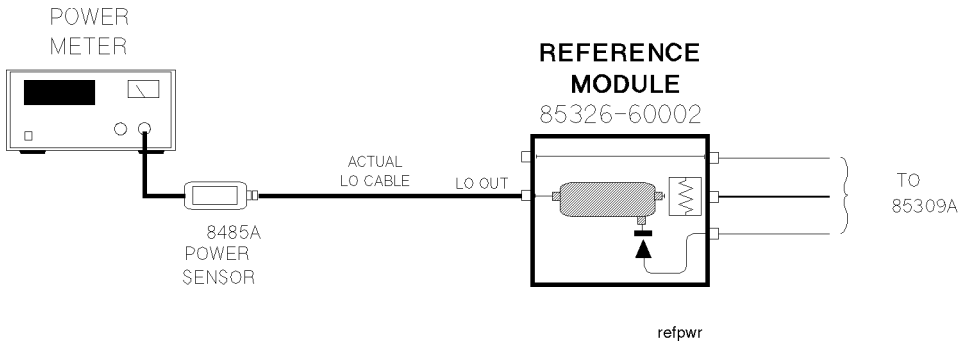

Figure 1-4 Measuring LO Power from the Reference Module

4. Measure the power output of the reference module as shown in Figure 1-4. Be sure to measure power at the *end* of the LO cable.

Adjust the LO Power to the Reference Mixer

1. Adjust the HP/Agilent 85309A front panel LO POWER ADJUST control until the power meter reads between 17 and 17.8 dBm. The “LO POWER OUT OF RANGE” light should be off.
2. Note the reading of the HP/Agilent 85309A display and write it down here:

Agilent 85326A DETECTOR VOLTAGE SETTING:_____ millivolts

If the *LO power adjust* setting is ever changed, you can return to the appropriate power level for the millimeter system by referring to this setting. To return to the original power level, Turn the LO POWER ADJUST knob until the voltage reading matches the value written above.

To find the maximum unleveled power, disconnect the detector voltage feedback cable at the reference module while monitoring the power level as shown in Figure 1-4 on page 1-11. Remember to perform the test within the frequency range of operation.

NOTE

When performing the following step, connect the LO, IF, and detector voltage cables to the reference MODULE first, then connect cables to the mixer. This lowers the risk of electrostatic damage to the mixers.

3. Connect the reference mixer to the reference module and directional coupler, refer to Figure 1-5.

   The warning beeper should now stop.
4. Press **[ENTRY OFF]** to remove the error message from the receiver display.

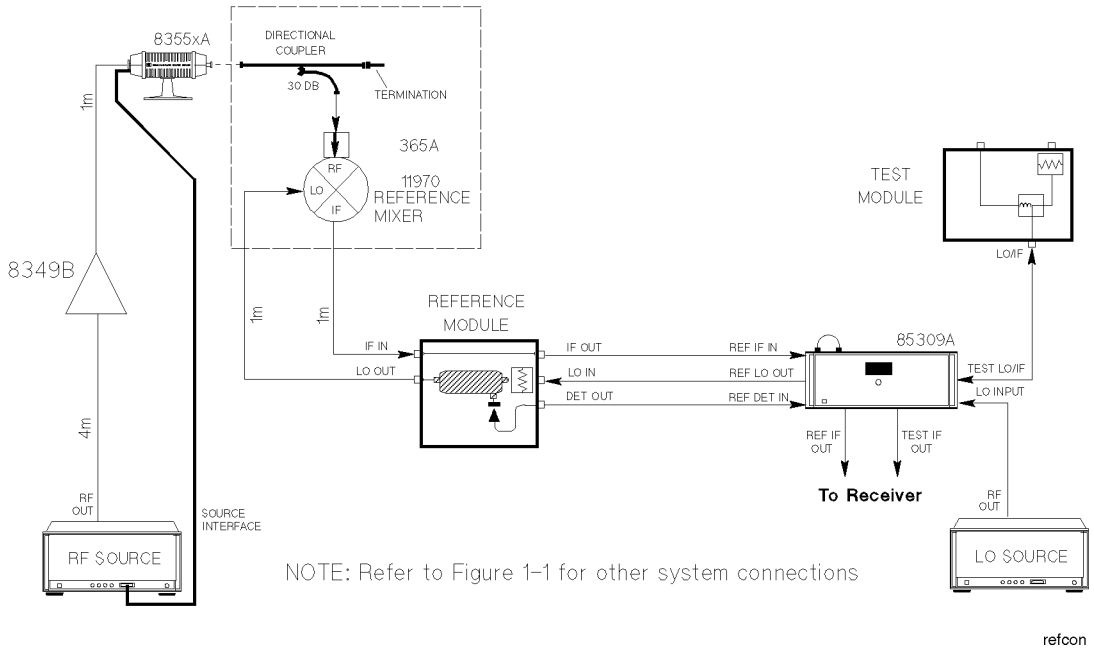

Figure 1-5 Reference Mixer Connections

Adjust the LO Power to the Test Mixer

1. Zero the power meter.
2. Measure the LO power output of the test module as shown in Figure 1-6.

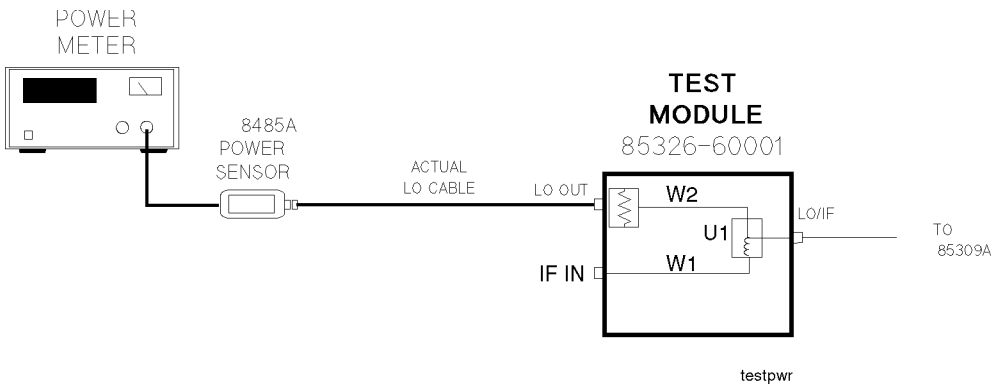

Figure 1-6 LO Power Measurement Point for Test Module

3. The LO power should be between +16 and +17 dBm. If the LO power is outside this range, you must change the amount of attenuation inside the test module. This is accomplished by adding or removing attenuators inside the module.

   Use various combinations of the 1, 2, and 4 dB attenuators to adjust the LO power to the required range.

4. If you have more than one test module, repeat power measurement for each test channel module as explained above.

Procedure 2

This procedure applies to systems that use HP/Agilent 85320A/B mixers, in addition to the Agilent 85325A.

Initial Setup

1. Refer to the detector voltage label on the HP/Agilent 85320B reference mixer. Set the HP/Agilent 85309A “LO POWER ADJUST” control to match this value. You do *not* need to connect the HP/Agilent 85320B mixer to the system.
2. Zero and calibrate the power meter.
3. Determine the power sensor calibration factor at 4 GHz, and set the power meter accordingly.
4. Connect the power sensor to the LO output of the Agilent 85326A reference module (refer to Figure 1-4 on page 1-11). Be sure to connect the power sensor to the *end* of the LO cable.

Checking the Reference LO Power

1. Measure the power output of the reference module.
   a. If measured power is between 15 and 17.5 dBm, no adjustment is necessary. Go directly to the *Adjusting LO Power to the Test Mixer* section on page 1-15.
   b. If the measured level is outside of the above range, you will have to change the LO power whenever you switch between HP/Agilent 85320A/B and Agilent 85325A mixer systems. For HP/Agilent 85320A/B mixers, refer to the *HP/Agilent 85320A/B Mixer Modules User's Guide.*

   Since you must set the LO power separately for each type of mixer, adjust the LO power for the millimeter-wave mixers at this time. To do this, perform Procedure 1, starting at “*Adjusting LO Power to the Reference Mixer.*” on page 1-12.
2. Adjust the HP/Agilent 85309A front panel LO POWER ADJUST control until the power meter reads between 17 and 17.8 dBm. The “LO POWER OUT OF RANGE” light should be off.
3. Note the reading of the HP/Agilent 85309A display and write it down here:

HP/Agilent 85326/85320 DETECTOR VOLTAGE SETTING: _____ millivolts.

If the LO POWER ADJUST setting is ever changed, you can return to the appropriate power level for the millimeter system by referring to this setting. To return to the original power level, Turn the LO POWER ADJUST knob until the voltage reading matches the value written above.

NOTE

When performing the following step, connect the LO, IF, and detector voltage cables to the reference module first, then connect cables to the mixer. This lowers the risk of electrostatic damage to the mixers.

4. Connect the reference mixer to the reference module and directional coupler, refer to Figure 1-5 on page 1-13. The warning beeper on the receiver should stop.
5. Press **[ENTRY OFF]** to remove the error message from the receiver display.

Adjust the LO Power to the Test Mixer

1. Measure the LO power output of the test module as shown in Figure 1-6 on page 1-13.
2. Look up the power level (see below) and perform the corresponding action.

   If power is:

   - **Less than 14.75 dBm:** Reduce the amount of attenuation in the test module until power is between 14.75 and 16.25 dBm.

NOTE

If you have removed all attenuators from the test module, and power is still less than 14.75 dBm, this means that you cannot switch between the Agilent 85325A mixers and your other mixers without readjusting LO power each time. Perform “Procedure 1" on page 1-11 to adjust LO power for the Agilent 85325A mixers. To adjust LO power for the other mixers, refer to the operating manual for those mixers.

   - **14.75 to 16.25 dBm:** Proper LO power, no further adjustment is needed.
   - **Greater than 16.25 dBm:** Add attenuation inside the test module until power is between 15 and 16.25 dBm.

3. If you have more than one test module, repeat the power measurement (the previous two steps) for each test module.

Mixer Operational Check

NOTE

[Brackets] indicate a front-panel key or computer keyboard.
{Braces} indicate a display softkey selection.

NOTE

When installing the mixers, connect the 3.5 mm cables to the test/reference modules *before* connecting them to the mixers. This will minimize the danger of an electrostatic discharge damaging the mixers.

1. Make sure the equipment is connected as shown in Figure 1-5 on page 1-13.
2. Press:

   STIMULUS **[MENU]** ***{STEP}***
3. Enter the start and stop frequencies of your millimeter band.
4. Make sure averaging is OFF by pressing:

   RESPONSE **[MENU]** ***{AVERAGING OFF}***
5. Measure the a1 input as follows:

   If using an HP/Agilent 8510, press:

   PARAMETER **[MENU]** ***{USER 1 a1}***

   If using an HP/Agilent 8530, press:

   PARAMETER **[MENU]**

   {SERVICE PARAMETERS}

   {SERVICE 1 a1}

   The signal you are measuring is from the coupled arm of the directional coupler.
6. Set the display reference value so the trace is centered vertically:

   Press **[REF VALUE]** and turn the rotary knob.
7. Write down the reference value, you will need it later in this procedure:

   REF VALUE = _____
8. Set display scale to 1 dB/division, press:

   [SCALE] [1] [x1]

9. Make sure the signal is at anticipated levels. The coupled arm attenuates the output of the HP/Agilent 8355xA by 30 dB (this can vary depending on the type of coupler used). Power flatness should be approximately +/-3 dB across the band.

10. Press:

    [DISPLAY]

    {DATA -> MEMORY}

11. Disconnect the reference mixer from the coupled arm of the directional coupler. Put the test mixer in its place, as shown in Figure 1-7.

NOTE If your system has more than one test channel, connect the coupled arm to the first test channel (TEST 1).

12. Connect the Test LO and Test IF cables to the *test module* first, then to the test mixer.

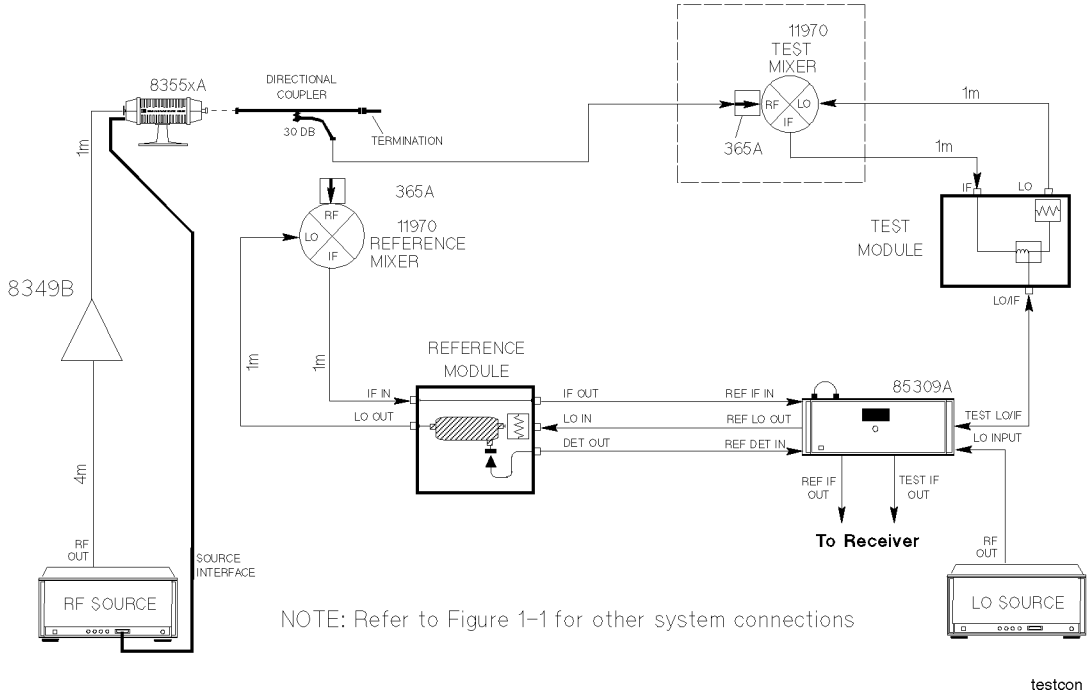

Figure 1-7 Test Mixer Connections

NOTE Perform steps 13 through 18 ONLY if using a synthesized LO source. Proceed to “When Using an HP/Agilent 8350 LO Source” on page 1-18 if you have an HP/Agilent 8350 LO source.

13. Determine which receiver input has the test signal connected to it (b1, b2, or a2).
14. Measure that input using the USER softkeys (on HP/Agilent 8510) or SERVICE PARAMETER softkeys (on HP/Agilent 8530).
15. Press:

    [DISPLAY]

    {SELECT DEFAULTS}

    {DEFAULT to MEMORY: 1}

    {DATA and MEMORY}

    Adjust the display reference so the two traces are centered vertically. Refer to the value you wrote down in Step 7.
16. Set display scale to 1 dB/division.
17. Make sure the two signals are within 3 dB of each other.
18. If your system has more than one test channel, check each one in the same way.

When Using an HP/Agilent 8350 LO Source

Perform the following steps ONLY if using an HP/Agilent 8350 LO source:

1. Press ***{DATA and MEMORY}***
2. On the rear panel of the HP/Agilent 85309A:
   a. Disconnect the green (b2) wire from the TEST IF OUT connector.
   b. Move the brown (a1) cable from the REFERENCE IF OUT connector to the TEST IF OUT connector.
3. Make sure the two displayed traces are within 3 dB of each other. (This step is required so the receiver can phase lock.)
4. If your system has a second test channel:
   a. Move the red (b1) wire to the TEST IF OUT connector.
   b. Make sure the two displayed traces are within 3 dB of each other.
5. If your system has a third test channel:
   a. Move the yellow (a2) wire to the TEST IF OUT connector.
   b. Make sure the two displayed traces are within 3 dB of each other.
6. Move the a1 and b2 (and possibly b1 and a2) input lines back to their original configuration.

Saving the Setup

NOTE

[Brackets] indicate a front-panel key or a computer keyboard.
{Braces} indicate a display softkey selection.

Press **[SAVE]** ***{USER PRESET 8}*** to save the current instrument setup. Whenever you press **[USER PRESET]** or turn the receiver *on*, the proper settings for this system will be recalled.

Final Installation

This procedure assumes that the other components of the antenna measurement system are already connected. Refer to the installation instructions for the receiver or HP/Agilent 85310A if necessary.

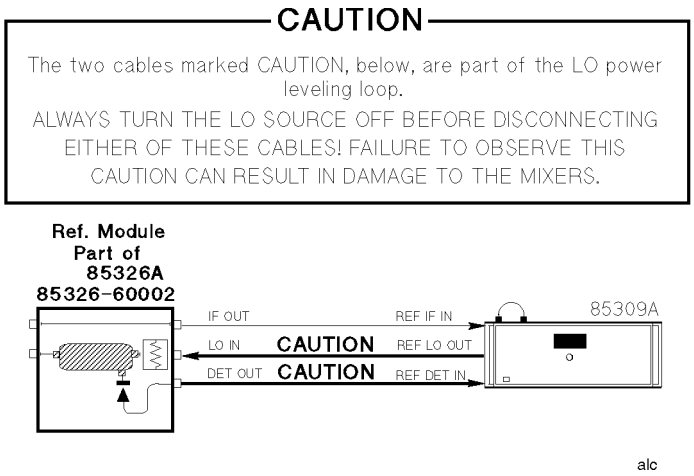

Figure 1-8 Leveling Control Cables

CAUTION

If you disconnect the detector voltage cable (while the LO source is *on*), LO power will go to maximum. This will damage the millimeter-wave mixers as soon as they are connected.

If you disconnect the LO signal cable, the LO power will go to maximum while the HP/Agilent 85309A tries to send the appropriate amount of power to the mixers. If you then reconnect the LO cable, the LO power to any connected mixer will initially be at damage levels. The HP/Agilent 85309A will detect the high LO power and reduce it, but the mixers could be damaged before power is reduced.

Remember that the HP/Agilent 85309A sends the same LO power to both mixers. If high LO power occurs then both millimeter-wave mixers may be destroyed.

Do not connect LO power to the HP/Agilent 11970 mixers *until you adjust the LO power.* Refer to the “Mixer LO Power Level Adjustment” on page 1-8 If you connect LO power before adjusting it you could permanently damage the mixers.

Procedure

1. Move all system components to their final location.
2. Connect the system using one of these methods:
   a. If you are using a coupled reference channel, connect the system as shown in Figure 1-9 and Figure 1-10 on page 1-22.
   b. If you are using a radiated reference, connect as shown in Figure 1-11 on page 1-23.

Refer to Figure 1-1 on page 1-3 for system-level connections.

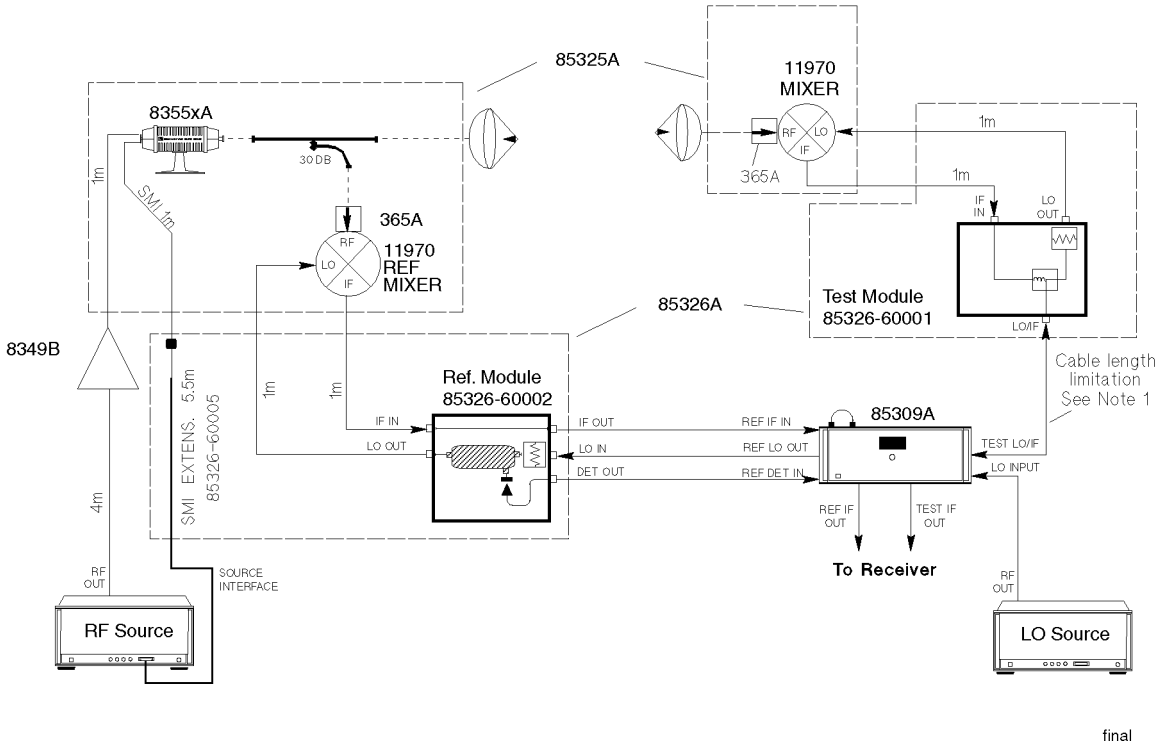

Figure 1-9 Agilent 85325A/85326A Installation Block Diagram (Coupled Reference)

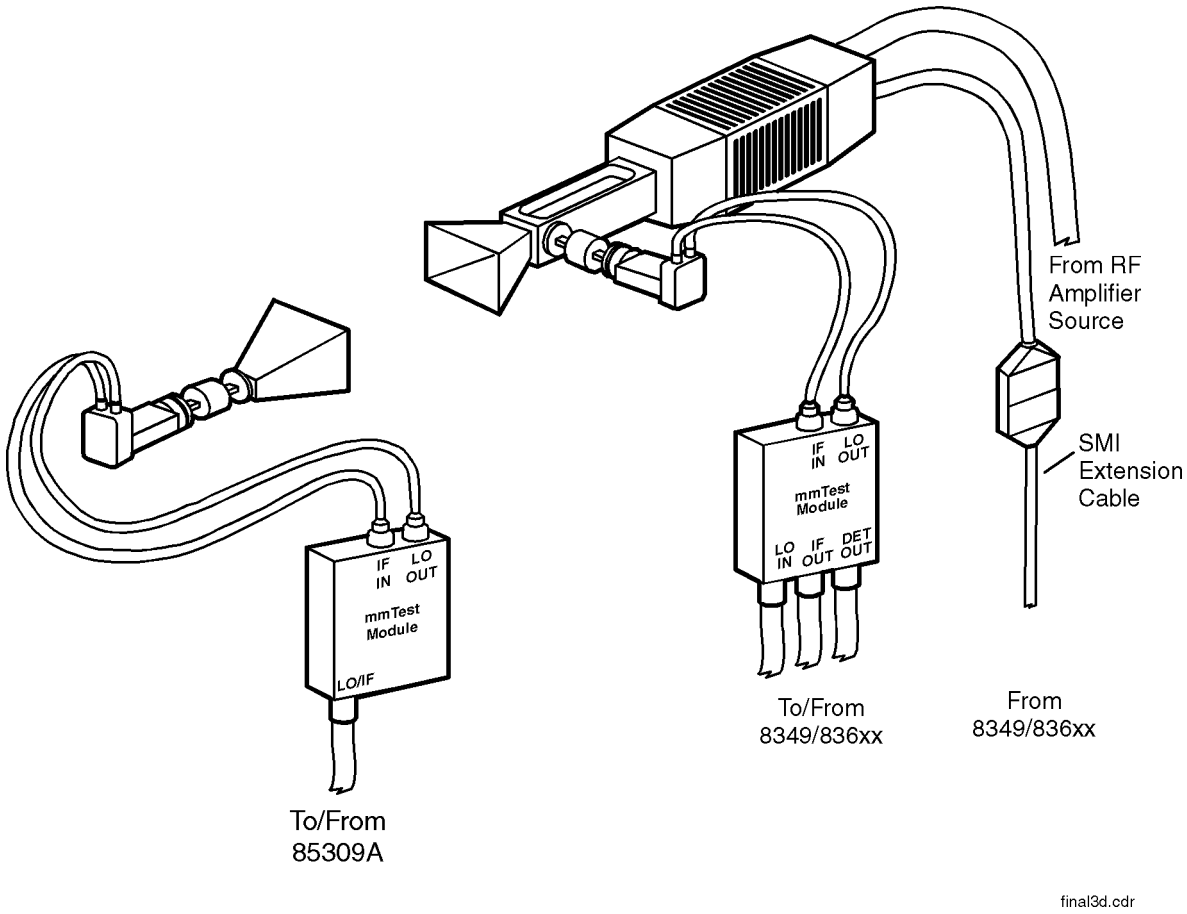

Figure 1-10 Agilent 85325A/85326A Visual Installation Diagram (Coupled Reference)

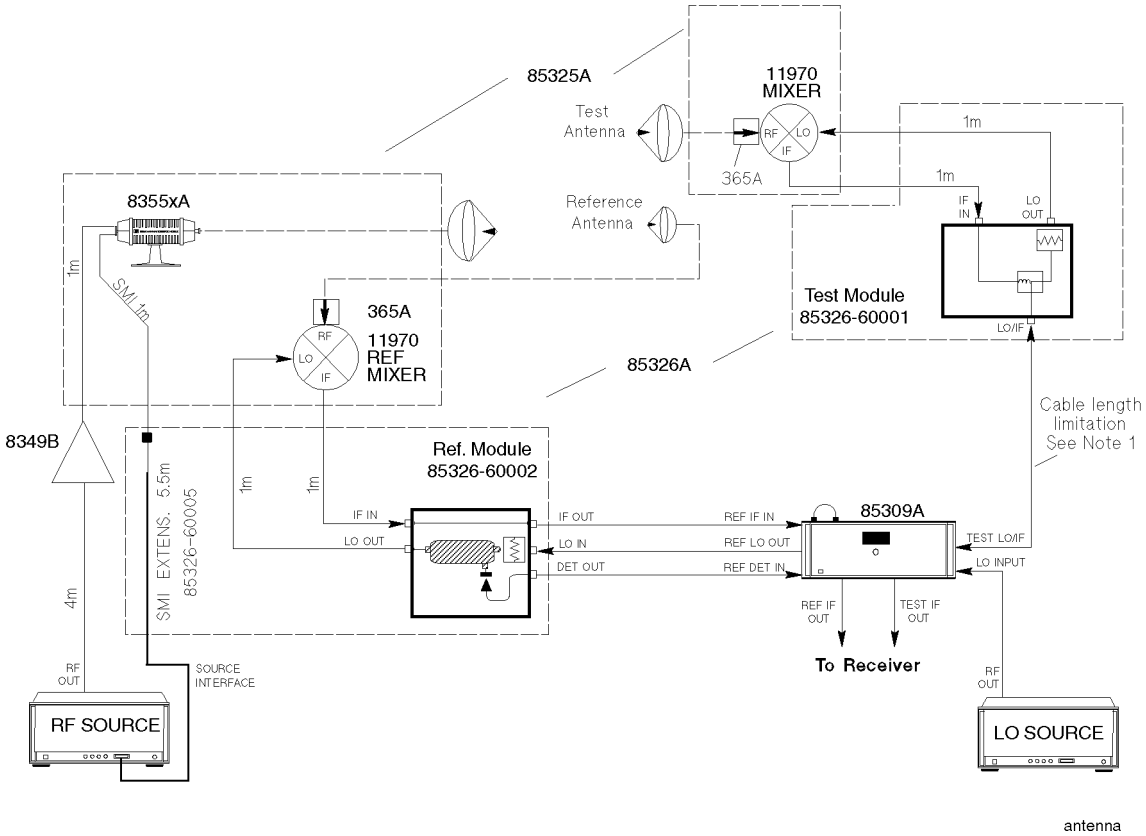

Figure 1-11 Agilent 85325A/85326A Installation Block Diagram (Radiated Reference)

If Using an HP/Agilent 8340/41 RF Source

If you are using an HP/Agilent 8340/41 as an RF source, refer to Appendix A for setup information.

Connecting the Waveguide

When connecting a waveguide, refer to Appendix B, “Connecting the Waveguide Properly.” Use the Waveguide Accessory Hardware Kit when connecting the waveguide components.

Proper Torque for Coax Connections

The coax RF connectors in the setup must be properly torqued or the system will not provide its best performance. Proper connection torque also keeps moisture out the connectors, and eliminates radio frequency interference (RFI) from the connector interface. The amount of torque required depends on the type of connector. Table 1-5 lists the proper torque values. *Do not over-tighten connectors.*

Table 1-5 Proper Connector Torque

Connector	Torque / cm-kg	Torque / N-cm	Torque / in-lbs	Wrench Part Number
Type-N	52	508	45	8710-1935
3.5 mm	9.2	90	8	8720-1765
SMA	5.7	56	5	8710-1582
2.4 mm	9.2	90	8	8720-1765

Turn ON AC Power

Turn ON the AC power for all of the components in the following order:

1. RF and LO sources, RF power amplifier
2. HP/Agilent 85309A LO/IF unit
3. Receiver

2 Operation

CAUTION

Leveling Feedback Loop

Never interrupt the LO leveling feedback from the reference module leveling coupler, detector, or leveling cables. Doing so can cause the LO power to exceed the damage level of the HP/Agilent 11970 mixers.

Electrostatic Discharge

When installing the mixers, connect the SMA cables to the test/reference modules *before* connecting them to the mixers. This will minimize the danger of an electrostatic discharge damaging the mixers.

NOTE

The Agilent 85325 millimeter wave system is designed to be used with a HP/Agilent 85310A or HP/Agilent 85301B. Refer to these manuals for system level operating information.

Mixer Operating Parameters

Operate the HP/Agilent 11970A mixers within the following operating parameters:

Maximum RF Input Power

CW: No greater than +20 dBm

Pulse: No greater than +24 dBm at $\leq$ 1 μs

Average: No greater than +20 dBm

Maximum LO Input Power

No greater than +20 dBm

Required LO Power

The HP/Agilent 11970 mixers require +14 to +18 dBm at the LO input.

Connector Care

Leave the plastic waveguide flange cap on whenever the system waveguide connectors are not connected together. This protects the mating surface from scratches, which can degrade performance.

Proper Waveguide Connector Alignment

If you are using Q, U, V, or W bands, waveguide flanges must be aligned properly or measurement errors may result. Refer to Appendix B.

3 General Information

Chapter Contents

- Product Description
- Specifications
- MM-Wave Source and Mixer Characteristics
- Supplied Equipment
- Maximum Cable Lengths

Product Description

The Agilent 85325A millimeter subsystem is designed for use with the HP/Agilent 85309A distributed frequency converter. The subsystem (in conjunction with the transmit RF source, source amplifier, and HP/Agilent 85309A) downconverts mm-wave frequencies to a 20 MHz IF signal. This IF signal is required by the HP/Agilent 8510 or HP/Agilent 8530 receiver.

The frequency range of your millimeter-wave system depends on whether you are using an R, Q, U, V, or W band source module.

Specifications

About Specifications

- All millimeter bands are specified with HP/Agilent 11970 harmonic mixers.
- Sensitivity is defined as *signal equals noise*. Averaging will improve sensitivity by 10 log x (averaging factor).
- Channel isolation is the coherent RF leakage from the reference mixer to the test mixer with inputs terminated.
- To insure best system performance, take care in connecting all waveguide flanges by securing all four screw points. Appendix B explains how to connect waveguide connectors properly.
- For specified performance of the mm-wave source, refer to documentation for the RF source module used.

Table 3-1 R, Q, and U Band System Level Specifications

	Agilent R85325A R Band	**Agilent Q85325A Q Band**		**Agilent U85325A U Band**	
Frequency Range (GHz)	**26.5 to 40 GHz**	**33 to 40 GHz**	**40 to 50 GHz**	**40 to 48 GHz**	**48 to 60 GHz**
mm Wave Source Module	HP/Agilent 83554A	HP/Agilent 83555A		HP/Agilent 83556A	
Max. Output Power (dBm) [1]	+7	+3	+3	+3	+3
Sensitivity (dBm) (S/N = 1, with 0 averages	-88	-85	-85	-86	-86
Sensitivity (dBm) (S/N = 1, with 128 averages)	-109	-106	-106	-107	-107
Dynamic Range (dB) (0 averages)	-79	-71	-77	-72	-78
Compression Lvl (dBm) [1] (at 0.1 dB)	-19	-24	-21	-24	-21
Channel Isolation (dB) (reference to test)	-100	-100	-100	-100	-100
Typical Match [1] (dB)	15.5	15.5	15.5	15.5	15.5

1. the input of test and reference isolators.

Table 3-2 V and W Band System Level Specifications

	Agilent V85325A	**Agilent W85325A**
Frequency Range (GHz)	**50 - 75 GHz - V Band**	**75 - 110 GHz - W Band**
mm Wave Source Module	HP/Agilent 83557A	HP/Agilent 83558A
Sensitivity (dBm) (S/N = 1, with 0 averages	-78 (-82 typical)	-71 (-74 typical)
Sensitivity (dBm) (S/N = 1, with 128 averages)	-99 (-103 typical)	-92 (-95 typical)
Dynamic Range (dB) (0 averages)	60 (68 typical)	56 (62 typical)
Compression Lvl (dBm) (at 0.1 dB)	-18	-15
Channel Isolation (dB) (reference to test)	-100	-100
Typical Match [1] (dB)	9.5	9.5

1. At the input of test and reference isolators.

MM-Wave Source and Mixer Characteristics

The following tables identify the INPUT and OUTPUT characteristics of the HP/Agilent 8355xA series millimeter-wave sources and HP/Agilent 11970x mixers.

Table 3-3 MM-Wave Source Information

MM Source Model #	Output Frequency	MM-Wave Output[1]	Harmonic Number	RF Input Level
HP/Agilent 83554A	26.5 - 40 GHz	7 dBm	2	+17 dBm
HP/Agilent 83555A	33 - 50 GHz	3 dBm	3	+17 dBm
HP/Agilent 83556A	40 - 60 GHz	3 dBm	3	+17 dBm
HP/Agilent 83557A	50 - 75 GHz	3 dBm	4	+17 dBm
HP/Agilent 83558A	75 - 110 GHz	0 dBm	6	+17 dBm

1. At 25°C ± 5°C

Table 3-4 MM-Wave Mixer Information

Mixer Model #	RF Frequency Range	Harmonic Number	LO Power Level
HP/Agilent 11970A	26.5 - 40 GHz	8	+16 ± 2 dBm
HP/Agilent 11970Q	33 - 50 GHz	10	+16 ± 2 dBm
HP/Agilent 11970U	40 - 60 GHz	10	+16 ± 2 dBm
HP/Agilent 11970V	50 - 75 GHz	14	+16 ± 2 dBm
HP/Agilent 11970W	75 - 110 GHz	18	+16 ± 2 dBm

Supplied Equipment

The following items are supplied with the Agilent 85325A and the Agilent 85326A.

Table 3-5 Supplied Parts

Description	Standard Quantity	Option 001 Quantity	Option 002 Quantity	Model or Part Number
With the Agilent 85325A:				
MM-Wave Source Module	1	1	1	HP/Agilent 8355xA
Directional Coupler	1	1	1	HP/Agilent 752D
Mixers	2	3	4	HP/Agilent 11970 C01
Isolators	2	3	4	HP/Agilent 365A
1/4 inch Wrench	1	1	1	8710-0510
3/16 inch Wrench	1	1	1	8710-0013
3/32 Hex Ball Drive	1	1	1	8710-1539
4-40, 0.4 inch Screws	50	50	50	3030-0221
4-40, 0.5 inch Screws	50	50	50	3030-0209
4-40 Hex Nuts	50	50	50	2260-0002
4-40 Captive Screws	50	50	50	1390-0765
With the Agilent 85326A:				
T-10 TORX Driver	1	1	1	8710-1623
5/16 inch Wrench	1	1	1	8720-0015
4 dB Attenuator[1]	1	2	3	0955-0208
2 dB Attenuator[2]	2	3	4	0955-0301
1 dB Attenuator[2]	2	3	4	0955-0321
With both:				
Operating and Service Manual	1	1	1	85325-90065

1. This attenuator is shipped inside the test module.

2. These attenuators are shipped inside the test and reference modules.

Maximum RF Cable Lengths

In millimeter-wave systems, there is a length limit on the HP/Agilent 85381A LO cable that goes from the LO source to the LO INPUT of the HP/Agilent 85309A (L_S) and the L_R cable (the cable that goes between the REF LO OUT of the HP/Agilent 85309A and the LO IN on the reference module).

L_S = source module cable
L_R = reference module cable
L_T = test module cable

Refer to Figure 3-1 and Table 3-6 to determine the maximum L_S length.

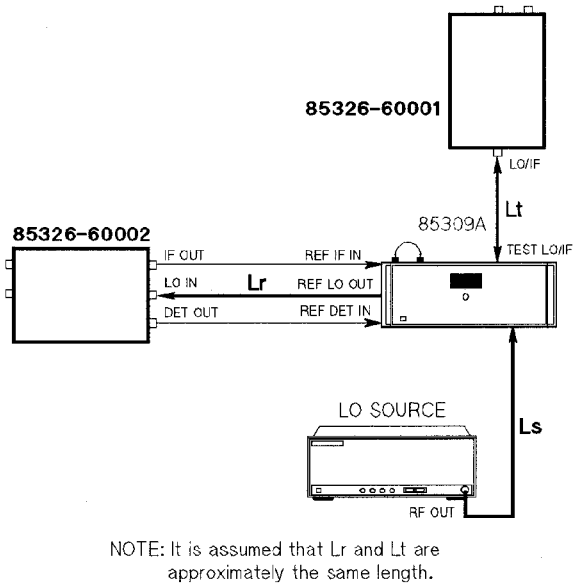

Figure 3-1 L_S, L_R, and L_T Cables

Table 3-6 Maximum Cable Lengths (meters)

Cable Type	LO Frequency (max) GHz	LO Source to HP/Agilent 85309A (L_S)	HP/Agilent 85309A to Agilent 85325A/B (L_R, L_T)
HP/Agilent 85381A	6	17	6
MaCom FA29RX	6	18	11

Formulas for Cable Length Maximums

The maximum LO source frequency required when driving the HP/Agilent 11970x waveguide mixers is 6.11 GHz. The two cable lengths (L_R and L_T) are affected by this maximum frequency. Refer to the diagram below.

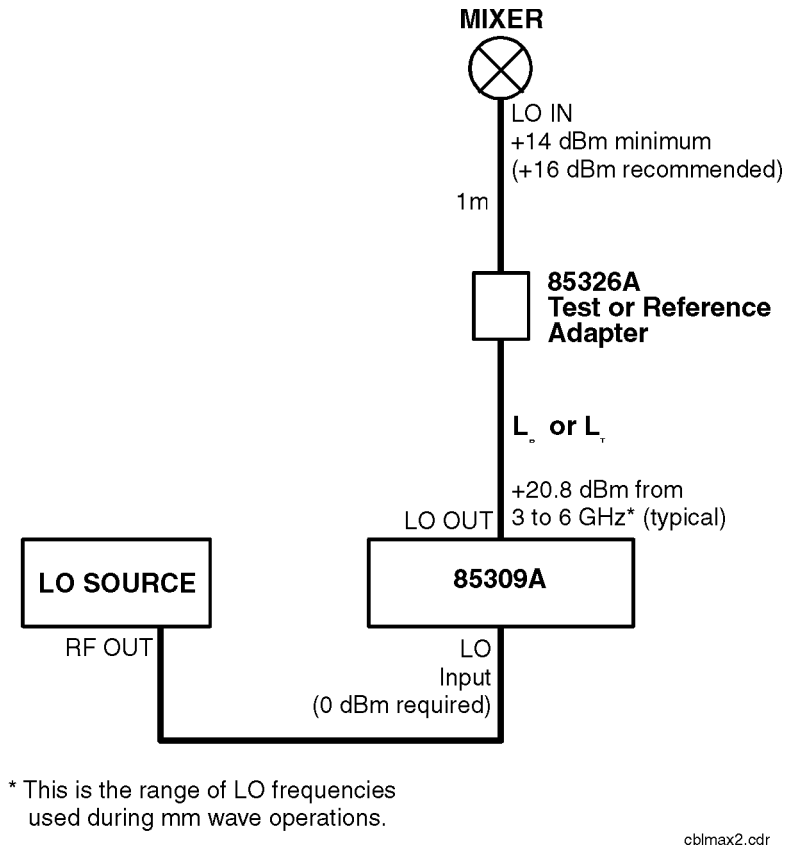

Figure 3-2 L_S, L_R, L_T Cable Lengths, Example

The maximum length of the LO cables (L_R or L_T) is a function of:

a. the LO power required by the mixers

b. the LO output power available from the HP/Agilent 85309A across the LO frequency range (3 to 6 GHz)

c. the loss through other microwave components in the LO path.

NOTE

Test and reference cables must be the same length.

The output LO power of the HP/Agilent 85309A is normally greater than +20.8 dBm between 3 and 6 GHz. The mixers require a nominal +16 dBm (+14 dBm minimum). The difference between these two LO power levels (+20.8 dBm and +16 dBm) determines the maximum loss of the test and reference path.

The loss through the Agilent 85326A and the associated 1 meter cable is about 1.6 dB. The loss associated with either the L_R or L_T cables cannot exceed 3.2 dB.

If using an HP/Agilent 85381A type cable, the length should not exceed 5 meters.

CAUTION

The damage level for the HP/Agilent 11970x mixer is +20 dBm. This can occur if the ALC loop is broken and the proper setup procedure was not used for the Agilent 85325A internal attenuator values.

4 System Performance Verification

Introduction

NOTE

This software is intended for R-band, Q-band, V-band and W-band. For U-band, contact Agilent Service and Support office, (see “Service and Support”on page vi) for U-band verification information.

This performance verification should be performed at least once a year.

This procedure verifies that the millimeter subsystem meets or exceeds its published specifications. Specifications are listed in Chapter 3. If traceability to a local standards organization is required, then it can be done with this procedure. One such standards organization is the United States National Institute of Standards and Technology.

The performance verification is composed of two parts:

- transmitter verification
- receiver verification

The transmitter verification should be performed first. This allows the receiver verification to be run with a transmitter that is known to be within specifications.

Recommended Test Equipment

The following tables list major instruments required for performing the millimeter wave measurement system verification. Substitute test instruments can be used if they meet or exceed the critical specification shown in the Table 4-1 on page 4-2 and Table 4-2 on page 4-3. “No substitute” means you must use the listed device. Miscellaneous adapters and cables are also required, and may not be listed in the tables.

To determine the recommended equipment for testing each of the millimeter wave system instruments, refer to the manual for that instrument.

Non-Banded Equipment

Table 4-1 shows equipment that is not millimeter wave band dependent. The equipment can be used with any millimeter system.

Table 4-1 Recommended Test Equipment (non-banded)

Item	Critical Specification	Recommended Model (or Part Number)
The following equipment is part of the antenna measurement system		
Receiver	No substitute	HP/Agilent 8510B/C or HP/Agilent 8530A
LO Source	HP/Agilent 8350, HP/Agilent 8340 or HP/Agilent 8341	HP/Agilent 8360 series
LO/IF Unit	No substitute	HP/Agilent 85309A
RF Source	HP/Agilent 8350, HP/Agilent 8340 or HP/Agilent 8341	HP/Agilent 8360 series
Amplifier[1]	Frequency band of test	HP/Agilent 8349A
Computer Requirements		
IBM-PC compatible computer	No substitute	
Pentium 133 or better	No substitute	
Windows 95®, Windows 98®, Windows NT® 4.0 installed		
GPIB interface card and cable (Hewlett-Packard® or National Instruments®)		
HP BASIC for Windows, version 6.32 or later installed		
A CD-ROM reader		
Internet Explorer ®4.0 or higher, or Netscape® 4.0 or higher		
System performance verification software		HP/Agilent 8511A,B and Antenna Measurement System Performance Verification Software
Additional Equipment Needed		
Printer	Windows compatible	
Power Meter[2]	No substitute	HP/Agilent 436A,437B,438A, E4418, E4419
Power Sensor[3]	No substitute	HP/Agilent 8485A, 8481A or 8487A
Connector Adapters	Type-N and 3.5 mm	Various[3]
Torque Wrench	No substitute	Refer to Table 4-3 on page 4-6

1. Not all antenna test systems will use an amplifier.

2. For traceability verification the Power Meter and Power Sensor should be traceable. No other traceable instruments are required.

3. Type-N(m) to 3.5 (f), type-N (f) to 3.5 (f), 3.5 (f) to 3.5 (f).

Band-Dependent Equipment

Table 4-2 shows equipment that is millimeter wave band dependent. Fixed terminations, variable attenuators, and directional couplers are only usable in one band. Therefore, if your system has more than one millimeter wave band, you must have a termination, variable attenuator, and directional coupler for *each band*.

NOTE

U-band: Contact Agilent Service and Support (see “Service and Support”on page vi) for U-band verification information.

Table 4-2 Recommended Test Equipment (banded)

Item	Critical Specification	Recommended Model or Part Number
Power Sensor	No substitute	R-band: HP/Agilent R8486A Q-band: HP/Agilent Q8486A V-band: HP/Agilent 8486A W-band: HP/Agilent W8486A
Fixed Termination[1]	Return loss >30 dB	R-band: HP/Agilent R910A Q-band: HP/Agilent Q910A V-band: HP/Agilent V910C W-band: HP/Agilent W910C
Variable Vane Attenuator	0 to 40 dB attenuation	R-band: HP/Agilent R382A Q-band: HP/Agilent Q382A V-band: Millitech DRA-15 (v-band) W-band: Millitech DRA-10 (w-band)
Directional Coupler	Coupling factor 10 dB	R-band: HP/Agilent R752C Q-band: HP/Agilent Q752C V-band: HP/Agilent V752C W-and: HP/Agilent W752C

1. You must have a fixed termination for each test channel of your system

Receiver Performance Verification

Overview

The performance verification software is used to verify the performance of millimeter and microwave downconverters. These downconverters are used in the HP/Agilent 8511A/B and the HP/Agilent 85301B Systems with HP/Agilent 85320A/B or HP/Agilent 85325A/B mixers (HP/Agilent 11970 Series Mixers).

The receiver performance verification checks the receiver section of the antenna measurement system. The tests are divided into two sections.

System Configuration

Sets up the millimeter wave system for verification. It is also used to input the system hardware's model and serial numbers.

Measurement Parameters Section

These test the various parameters of the receiver system. The results of these tests are used to calculate the specified parameters in the section below. It is possible to have one of these tests fail but still be within the specified parameters of the millimeter subsystem. These tests consist of:

RF to IF Conversion

Measures the power loss of the mixers when the RF signal is converted to the IF signal. This is not a specified system performance parameter.

IF Noise

Measures sensitivity (the RMS noise level of the trace data when the test or reference channels are terminated with a 50 ohm load). This is not a specified system performance parameter.

Crosstalk

Measures signal leakage between the antenna reference and the test channels. This is a specified system performance parameter.

Compression

Measures input power at which the mixers exhibit 0.1 dB compression. This is a specified system performance parameter.

Calculation Parameters Section

The results of the above section is used to calculate the specified parameters of the millimeter subsystem. These tests consist of:

Tracking Results

Calculates the conversion gain tracking between channels using RF to IF conversion measurements from the first section.This is not a specified system performance parameter.

Sensitivity Results

Calculates the actual sensitivity of the receiver in RMS power using IF Noise and RF to IF Conversion measurements from the first section.This is a specified system performance parameter.

Crosstalk Results (isolation)

Calculates the actual crosstalk between all channels using Crosstalk and RF to IF Conversion measurements from the first section. This is a specified system performance parameter.

Dynamic Range Results

Calculates the dynamic range of the system using Compression, IF Noise, and RF to IF Conversion measurements from the first section. This is a specified system performance parameter.

Setting Up The Equipment

Procedure

1. The receiver, LO/IF unit, mixers, LO source, and cables should be in the same configuration in which they are normally used. Make sure that all cables are connected properly. All connectors should be properly torqued, refer to Table 4-3 for proper torque specifications.

*Table 4-3 **Proper Connector Torque***

Connector	Torque cm-kg	Torque N-cm	Torque in-lbs	Wrench Part Number
Type-N	52	508	45	8710-1935
3.5 mm	9.2	90	8	8720-1765
SMA	5.7	56	5	8710-1582
2.4	9.2	90	8	8720-1765

CAUTION Never exceed the recommended torque when attaching cables.

2. Connect test equipment to the system components as shown in Figure 4-1 on page 4-7. The mixers must be placed near the verification system during the performance verification.

CAUTION Do not connect the LO cables to the mm-wave mixers until the LO power level has been checked.

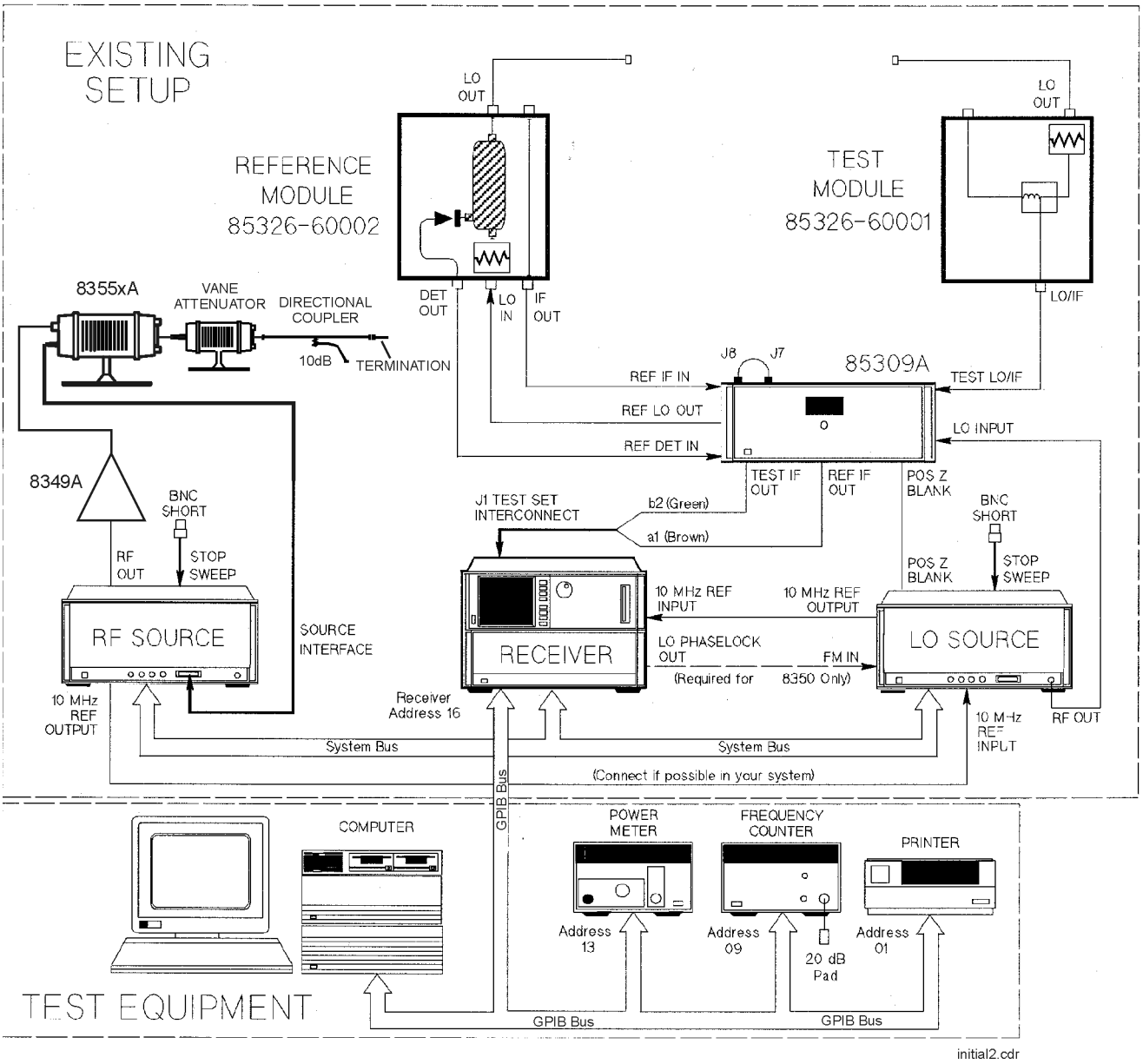

Figure 4-1 Initial Equipment Configuration

NOTE

This procedure assumes you will be using some of the cables from your actual range, specifically, the cables between the LO/IF unit and the mixers. This requires that the cables be pulled from their installation location so that the mixers can be placed near the verification system. If the cables cannot be pulled, they must be tested separately. In this case the mixers should be connected to the verification system with a backup set of HP/Agilent 85381 cables of the same type and length as the cables normally used in the system.

3. Turn on all equipment and allow it to warm up for one hour.

If you cannot bring the mixer down from the antenna tower, consider taking the RF source and power meter up to the mixers. In this case, two additional GPIB extenders* will be required: One to connect the power meter to the general GPIB bus, and one to connect the RF source to the receiver system bus.

4. Make sure the HP/Agilent 8360's language switches are set to the *Analyzer Mode* shown in Table 4-4. The HP/Agilent 8360A will not work with your antenna measurement system while set to the TMSL mode.

Table 4-4 Switch Positions for Analyzer Mode

L3	L2	L1	A5	A4	A3	A2	A1
0	0	1	X	X	X	X	X
0 =switch down. 1 = switch up							
X = leave as is							

Turn the HP/Agilent 8360A OFF, then ON to implement the switch change.

RF to IF Conversion

This procedure uses a power meter to calibrate the RF output power from a RF source. Next, the receiver measures this calibrated RF power across the frequency band. It then calculates the difference between the calibrated RF power and the power measured by the receiver. The difference between the two is the conversion gain (loss).

IF Noise Measurements

Low-level noise is the RMS noise level of the trace data when the channel is terminated with a low VSWR termination. Each channel (mixer) is tested across the frequency band to determine the RMS noise level.

Channel Crosstalk

This test measures the signal leakage from one channel to another channel. In this test a high power signal is input to one channel (mixer), and the other channel is terminated with a low VSWR termination. Either the “a1” or “a2” channel is used to phase lock the system.

* Ensure that the GPIB extender is set to slow mode.

Compression

This test measures the input power at which the mixer exhibits 0.1 dB compression.Each channel is tested over the test frequency range. Data is taken at 51 frequency points.

First, a power level is input to the test mixer that is within its normal operating range. The input to reference mixer is set to a much lower level. The test mixer output is ratioed to the reference mixer output and the data is put into memory. The data is then normalized to give a 0 dB reference,

Next, the input level is increased until the normalized data changes by 0.1 dB. The test mixer power level is the 0.1 dB compression point.

5 Service

Introduction

This chapter explains how to find and correct malfunctions in the millimeter-wave system. This chapter covers the following topics:

- Theory of Operation
- Recommended Test Equipment
- Receiver Troubleshooting
- Replaceable Parts
- Adjustments

Theory of Operation

A millimeter wave antenna measurement system (which uses an HP/Agilent 85309A frequency converter) consists of a transmitter and receiver section.

Figure 5-1 shows the block diagram of the antenna measurement system.

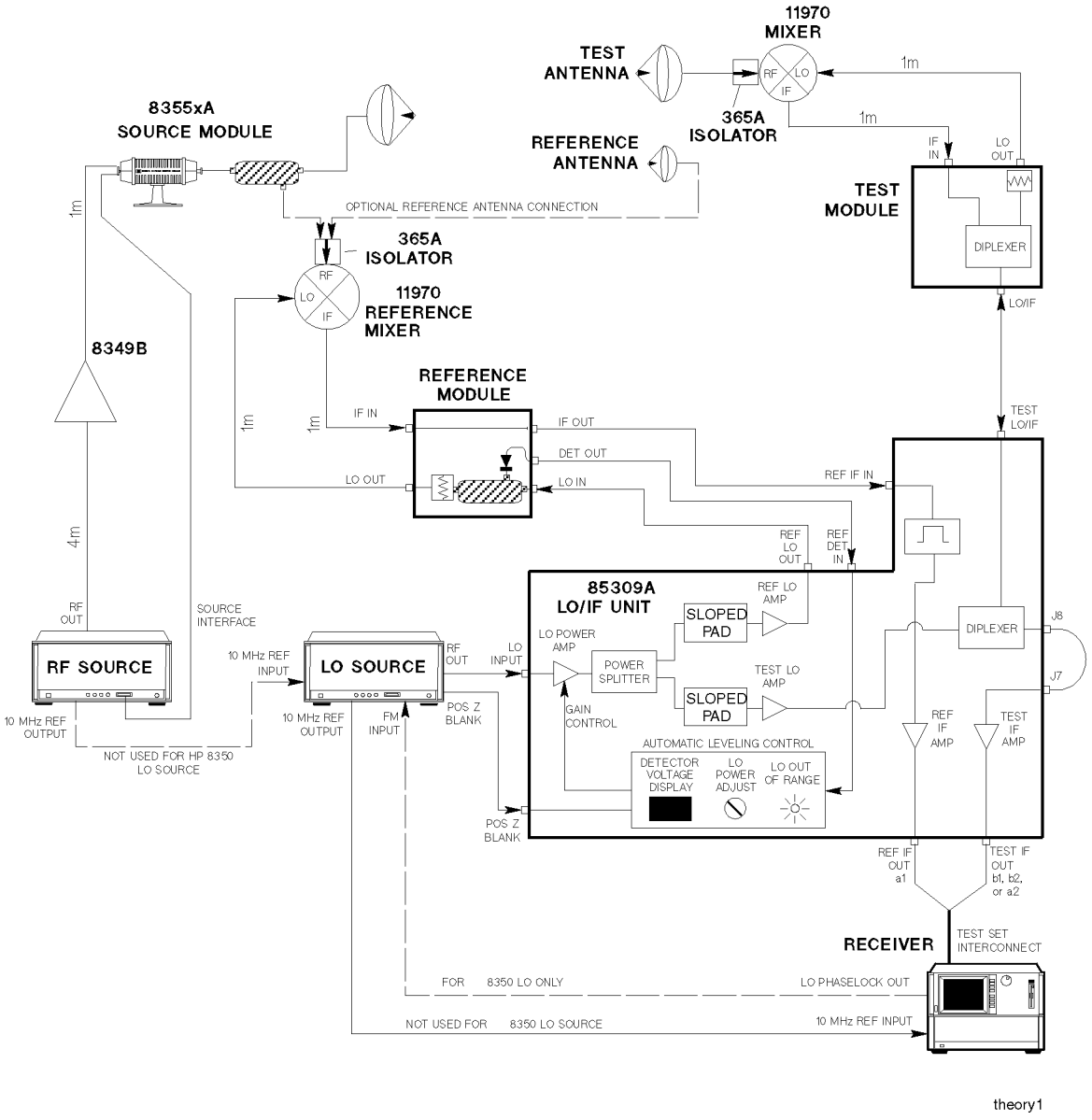

Figure 5-1 System Diagram

Transmitter Section

The transmitter consists of a synthesized RF source, amplifier, mm-wave source module, and transmit antenna. The RF source and transmit antenna provide the stimulus signal for the antenna being tested. The RF source is controlled by the receiver using the system bus. The RF source is called **SOURCE 1** in the receiver's softkey menus. GPIB extenders are required if the distance between the receiver and RF source exceeds IEEE 488.2 limits. Refer to *Allowable GPIB Cable Lengths* below.

The Purpose of Each Device in the Transmitter Section

Source and Amplifier

The RF source and amplifier provide the +17 dBm power level required by the mm source module.

MM Source Module (MM Head)

This module multiplies the RF frequency by a factor of 2, 3, 4, 5 or 6, depending on the model used. The source module interface (SMI) allows the source module to become an integrated part of the RF source. With the interface cable connected, the RF source knows that multiplied frequencies are being produced. Because of this, the source responds properly when the receiver asks for frequencies above its normal range. The source module accepts RF input power levels from +17 to +27 dBm.

The power output of the source module can be changed with the STIMULUS controls on the receiver. When the SMI cable is used, the HP/Agilent source module produces leveled mm-wave power.

Allowable GPIB Cable Lengths

You are allowed 2 meters of cable length for each instrument that is connected to the main GPIB bus (or to the system bus). A typical system has a computer, printer (or plotter), receiver, and positioner-controller connected to the main GPIB bus (four devices). The total GPIB cable length allowed in this example system is 2 x 4 = 8 meters. Under *no* circumstances can the total cable length ever exceed 20 meters, no matter how many devices are in the system.

If your system exceeds the allowed GPIB cable length, you must use GPIB extenders.

System Bus Cable Lengths

There are usually two instruments connected to this bus (the RF and the LO sources). Calculate the system bus limitation separately, using the same formula.

2 (meters/device) x 2 (devices) = 4 meters allowable length

Because the RF source is often far away from the receiver, GPIB extenders are commonly used. Always use the *slow mode* on extenders connected to the system bus.

Extender Recommendations

If using high speed “TURBO” (fast CW) modes, use fiber optic extenders for distances greater than 250 meters. Using coax at distances over 250 meters greatly slows the whole GPIB bus. This slows the data transfer to the system computer which results in slow measurements.

Always use Fast Mode on coax extenders connected to the main GPIB bus.

Always use Slow Mode on coax extenders connected to the HP/Agilent 8530A local bus.

Receiver Section

The receiver section consists of the antenna under test, reference antenna (or directional coupler), frequency converter, mm-wave mixer modules, mm-wave mixers, isolators and the receiver (HP/Agilent 8530 or HP/Agilent 8510).

Purpose of Each Device in the Receiver Section

Isolators There is an isolator on the input of each mixer. The isolators perform two functions:

- They improve the impedance match between the test or reference antenna and the mixers.
- The isolators stop mixer harmonic signals from radiating back toward the antennas, reducing crosstalk.

Mixers The HP/Agilent 8510 or HP/Agilent 8530 receivers cannot accept RF frequencies directly. Mixers are required to downconvert the RF frequencies to a 20 MHz IF frequency. The test and reference mixers are identical, but are driven by different types of mixer “modules.”

Mixer Modules Mixers must receive proper LO power (+16 ± 2 dBm) or they will not work properly. The *Reference Module* has an internal detector that measures the amount of LO power it receives. The detector's output voltage is sent to the HP/Agilent 85309A LO/IF unit, which controls the LO power level. This system does *not* measure power to the test module. It is assumed that the electrical distance to the test module is the same as the electrical distance to the reference module. Thus, the power arriving at the test module will be equal to the power arriving at the reference module. The system *cannot* control test and reference LO power independently.

The t*est module* has a diplexer, which allows the LO and IF signals to travel through the same cable. This allows you to use a single-ring rotary joint for the antenna under test.

HP/Agilent 85309A LO/IF Unit

The LO/IF unit performs the following functions:

- It amplifies and distributes LO power to the mixer modules.
- It keeps LO power at the desired power with it's automatic leveling control (ALC) circuitry.
- It receives IF power from each mixer module, amplifies it, and sends the
- IF signals to the receiver.
- It reduces crosstalk between the test and reference channels.

LO Source

The LO source supplies the LO signal which allows the mixers to downconvert RF frequencies to a lower IF frequency. The LO signal is amplified by the HP/Agilent 85309A LO/IF unit, which then splits the LO signal and routes it to both mixer modules. The LO source is controlled by the receiver using the system bus. The receiver's system bus designates the LO source as *SOURCE 2*. (In “Turbo Mode” configurations, the LO and RF sources are connected to the main GPIB bus.)

If you use a synthesized LO source, you must connect the timebase reference oscillators of the RF source, LO source, and receiver together. This ensures that the downconverted IF frequency is *exactly 20 MHz*. If distance prohibits the timebase connections, then adjustments to the LO timebase must be performed periodically. Refer to the *HP/Agilent 85310A Operating and Service Manual* for instructions.

NOTE

The HP/Agilent 85310 is a product that contains the HP/Agilent 85309A, along with *microwave frequency mixers*. The HP/Agilent 85310A manual describes the
HP/Agilent 85309A LO/IF unit in great detail.

Non-synthesized LO sources (HP/Agilent 8350) require a phase lock reference signal (LO PHASELOCK OUT) from the receiver, and do *not* require the timebases to be connected. Refer to the *HP/Agilent 85310A Operating and Service Manual* or *HP/Agilent 85301B Operating and Service Manual* for more information.

Receiver

The receiver's primary task is to take the 20 MHz IF signals from the LO/IF unit and convert them into digital data. The data is processed by the receiver and displayed.

The receiver also controls the frequencies produced by the RF and LO sources. This is done by means of the receiver's dedicated GPIB bus, called the System Bus. This bus is separate from the GPIB bus, and it's sole purpose is to allow the receiver to control slave instruments.

If the LO source is *not* synthesized (HP/Agilent 8350), then the receiver LO PHASELOCK OUT provides the phase lock signal. This signal is input to the HP/Agilent 8350 FM IN jack.

Recommended Test Equipment

The following tables list major instruments required for supporting the mm-wave measurement system. To determine recommended test equipment for each of the mm-wave system instruments, refer to the manual for that instrument. Substitute test instruments can be used if they meet or exceed the *Critical Specification* shown in Table 5-1 on page 8 and Table 5-2 on page 9. "No substitute" means you must use the listed device.

Miscellaneous adapters and cables are also required, and may not be listed in the tables.

Non-Banded Equipment

Table 5-1 shows equipment that is not mm-wave band dependent. The equipment can be used with any mm system.

Table 5-1 Recommended Test Equipment (Non-Banded)

Item	Critical Specification	Recommended Model or Part Number	Use[1]
Receiver	No substitute	See *Compatible Instruments*[2]	I, O, P, T
LO Source	No substitute	See *Compatible Instruments*[2]	I, O, P, T
LO/IF Source	No substitute	HP/Agilent 85309A	I, O, P, T
RF Source	No substitute	See *Compatible Instrument*[2]	I, O, P
RF Source	1 to 26.5 GHz[3]	HP/Agilent 83640B	T
Amplifier	No substitute	HP/Agilent 8349B	I, O
Power Meter	No substitute	HP/Agilent 436A, 437B, (for R, Q, or W bands)	IP, T
Power Sensor	No substitute	HP/Agilent 8485A, 8481A or 8487A	I, P, T
Connector Adapters	type-N and 3.5 mm	Various[4]	I, P, T
mmW Network Analyzer System	mm-wave band must match your system	HP/Agilent 8510C or 8510C opt. 011 system	T[6]
Spectrum Analyzer	Up to 20 GHz	Various	IT[5]
Additional Mixer[6]	mm band must match your system	HP/Agilent 11970A	IT

1. I = installation; O = operation; P = performance verification; T = troubleshooting and repair
2. Located in the HP/Agilent 85310A manual.
3. Must be controlled independently of receiver.
4. Type-N to 3.5 (f); Type-N (f) to 3.5 (f); 3.5 (f) to 3.5 (f).
5. Recommended for on-site use.
6. Required by spectrum analyzer.

Band-Dependent Equipment

Table 5-2 shows equipment that is mm-wave band dependent. Fixed terminations, variable attenuators, and directional couplers are only usable in one band. Therefore, if your system has more than one mm-wave band, you must have a termination, variable attenuator, and directional coupler for *each band*.

NOTE

U-band: Contact HP Service and Support (see "Service and Support" on page -vi) for U-band verification information.

Table 5-2 Recommended Test Equipment (Banded)

Item	Critical Specification	Recommended Model or Part Number	Use[1]
Power Meter		HP/Agilent E4418 and E4419	
Power Sensors[2]	Return loss > 14 dB	R-band: HP/Agilent R8486A Q-band: HP/Agilent Q8486A V-band: HP/Agilent V8486A W-band: HP/Agilent W8486A	P, T
Fixed Termination[2]	Return loss > 30 dB	HP/Agilent x910A[3]	P, T
Variable Vane Attenuator[2]	0 to 40 dB attenuation	HP/Agilent x382A[3] V-band, Millitech DRA-15 W-band, Millitech DRA-10	P
Directional Coupler[2]	Coupling factor 10 dB	HP/Agilent x752C[3]	P, T

1. I=installation; O = operation; P = performance verification; T = troubleshooting and repair

2. You must have one of these devices for each mm-wave band

3. Where x stands for the band R, Q, U, V, or W.

Troubleshooting

To troubleshoot the millimeter-wave system, refer to the Service chapter of the
HP/Agilent 85310A Distributed Frequency Converter Operating and Service Manual.

Special 5/16 Inch Wrench

A specially-modified 5/16 wrench is supplied with this product. The “closed” end has been machined to be smaller, and has been slotted so it will fit over a cable.

Replaceable Parts

Ordering Information

To order a part, contact the nearest Agilent Technologies office (See “Service and Support” on page vi.), or you can find a list of Agilent Technologies Service Centers on the web at `http://www.agilent.com/`.

How to Order Parts

If you need to order a replacement part, contact you nearest Agilent Technologies representative.

To order a part that is not listed in the replaceable parts lists, include the instrument model number, complete serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Agilent Technologies office.

MM-Wave Module Parts

Test Module

See Figure 5-2 for the component layout.

Table 5-3 Test Module (85326-60001)Parts

Reference Designator	Description	HP/Agilent Part Number
AT1	4 dB attenuator, coax	0955-0208
AT2	2 dB attenuator, coax	0955-0301
AT3	1 dB attenuator, coax	0955-0321
E1	Adapter, SMA (m) / (m)	1250-1159
J1	Connector, RF type-N	08340-60221
J2, J3	Connector, 3.5 mm bulkhead	5062-6618
U1	Diplexer	5086-7542
W1	Cable, SMA (m) / SMB (f)	85320-60003
W2	RF cable, reformable	85325-20004

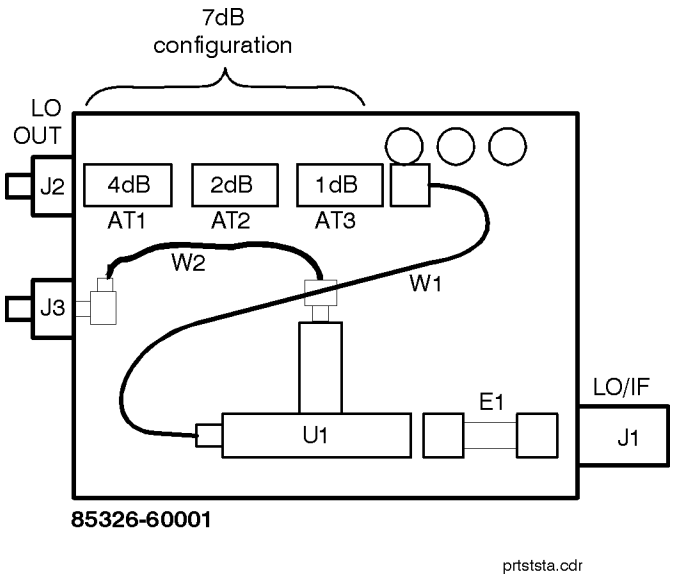

Figure 5-2 Agilent 85326A (85326-60001)

When Replacing a Diplexer

The diplexer has a dot on its case. This dot is next to the diplexer's LO port. When you install the new diplexer, make sure the end with the dot is connected to *the cable that goes to the LO OUT bulkhead connecto*r.

Reference Module

See Figure 5-3 for the component layout.

Table 5-4 Reference Module (85326-60002)Parts

Reference Designator	Description	HP/Agilent Part Number
AT1	2 dB attenuator, coax	0955-0301
AT2	1 dB attenuator, coax	0955-0321
D1	Directional coupler/detector	0955-0568
J1, J2, J3	Connector, RF type-N	08340-60221
J4, J5	Connector, 3.5 mm bulkhead	5062-6618
W1	Cable, IF through	85325-20006
W2	Cable, detector voltage	85325-60004
W3	Cable, reformable	85325-20004
W4	Cable, LO out	85325-20005

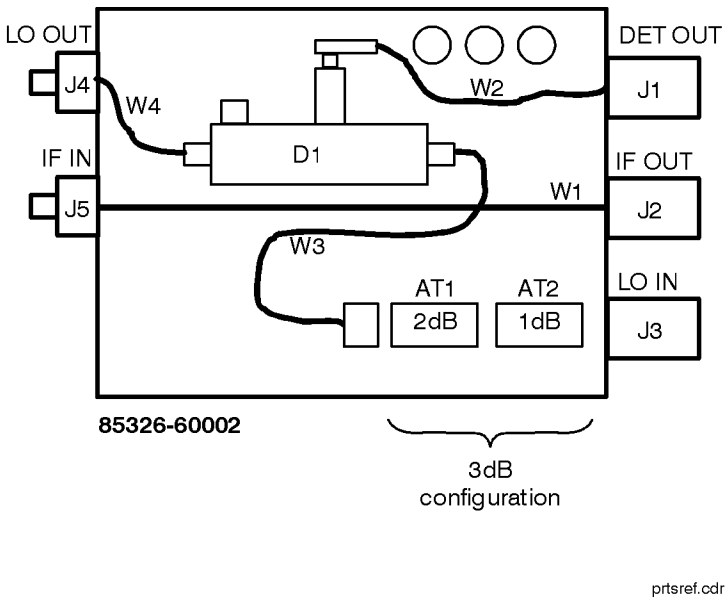

Figure 5-3 HP/Agilent 85356A (85326-60002)

Band-Related Parts

You receive a different directional coupler, mm-wave source module, detector, and isolator depending on the band of the system.

Table 5-5 Parts Supplied in Specific Bands

Description	Parts Supplied for R Bands	Parts Supplied for Q bands	Parts Supplied for U bands	Parts Supplied for V Bands	Parts Supplied for W Bands
Directional coupler	00752-60025	0955-0617	0955-0618	00752-60024	HP/Agilent W752D
MM source module[1]	HP/Agilent 83555A	HP/Agilen 83555A	HP/Agilent 83556A	HP/Agilent 83557A	HP/Agilent 83558A
Mixer[1]	HP/Agilent 11970A[2]	HP/Agilent 11970Q[2]	HP/Agilent 11970U[2]	HP/Agilent 11970V[2]	HP/Agilent 11970W[2]
Isolator	85325-60006 (HP/Agilent R365A)	85325-60005 (HP/Agilent Q365A)	85325-60007 (HP/Agilent U365A)	85325-60008 (HP/Agilent V365A)	85325-60009 (HP/Agilent W365A)
Waveguide straight	00899-60001	0955-0364			

1. This item can be repaired.

2. Must be equipped with option C01.

Repairing a Mixer or Source Module

The mm source module and mixers can be repaired rather than replaced. Contact your nearest Agilent service center for instructions on returning a unit for repair. These items are not field-serviceable.

Miscellaneous Parts

The following parts are supplied with each system.

Table 5-6 Miscellaneous Parts

Description	HP/Agilent Part Number
Screws, captive	1390-0765
Screws, 1/2 inch	3030-0209
Screws, 3/8 inch	3030-0221
Nut, hex 4-40	2260-0002
Nut, hex 4-40	2260-0009[1]
RF cable, SMA (m) / (m), 1 m	5061-5458
Wrench, 1/4 inch	8710-0510
Wrench, 3/16 inch	8720-0013
Torx driver T10	8710-1623
Modified wrench, 5/16[2]	08555-20097
Attenuator, fixed, 10 dB, 3.5 mm	HP/Agilent 8493C, opt. 010
Operating and Service Manual	85325-90001

1. Only supplied with R band.

2. This wrench is specially designed. The “closed” end has been machined to be smaller, and has been slotted so it will fit over a cable. The modified end has another feature as well, it slips when approximately 10 inch-pounds of force is exerted on the SMA connection. 10 inch-pounds is the torque specification for all SMA connections inside the mm-wave modules, or inside the HP/Agilent 85309A.

Adjustments

Only the HP/Agilent 85309A LO/IF unit requires periodic circuitry adjustments. Refer to the HP/Agilent 85310A or *HP/Agilent 85301B Operating and Service Manual* for HP/Agilent 85309A adjustment procedures. If the LO and RF source's timebases are not connected together, refer to either of the manuals (mentioned above) for adjustment instructions.

The LO power to the test and reference modules must be adjusted during installation. Refer to *Installation*, Chapter 1 for more instructions.

A

Using the HP/Agilent 8340/41 in Your System

Connect an HP/Agilent 8340/41 RF source as shown in Figure A-1.

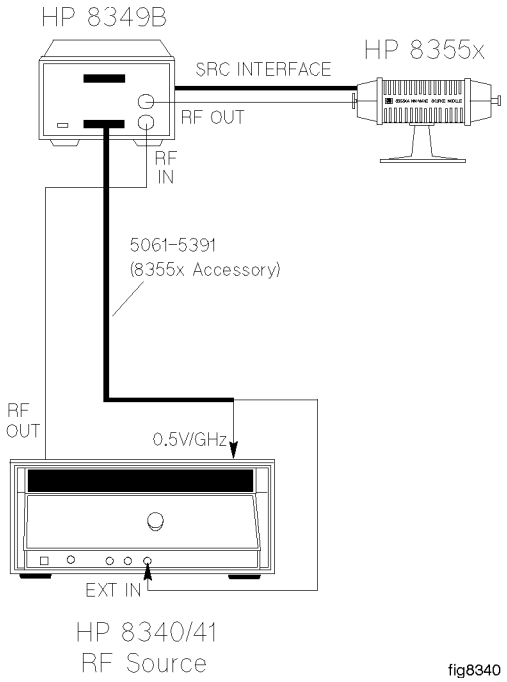

Figure A-1 HP/Agilent 8340/41 RF Source

B

Connecting the Waveguide Properly

Handling and Storing

Handle and store the devices with care; their continued performance and accuracy depend on maintaining precise mechanical tolerances. When the devices are not in use, replace their protective end caps.

Connecting Waveguide

Unlike threaded devices, waveguide mating planes are flanges (often precision) that you must carefully screw together. Always connect waveguide in the same flange orientation. For example, use the label as a reference and always connect a device with the label facing the same direction.

Wear

While connector wear can eventually degrade performance, properly connected waveguide flanges experience very little wear, and should have a long life.

Visual Inspection

Each time you make a connection, inspect mating surfaces for dirt, dust, foreign particles, or scratches which can degrade device performance. A damaged mating surface can damage any good surface connected to it. If necessary, clean all mating surfaces using alcohol and a lint-free swab or cloth.

Precision Flanges

A precision flange has four corner holes (for the screws) *and* two precision alignment holes, as shown in Figure B-1 below. A non-precision flange has only the four corner holes.

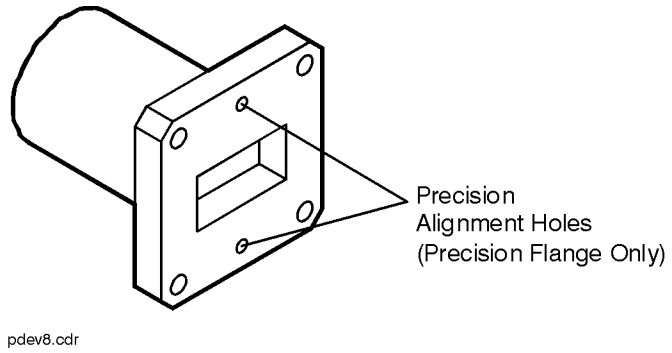

Figure B-1 Alignment Holes

If you wish to connect two precision flanges, refer to ““Aligning Two Precision Flanges” on page B-3.” If you wish to connect a precision flange to a non-precision flange, refer to *“Aligning Precision and Non-Precision Flanges” on page B-5.*

Aligning Two Precision Flanges

1. If necessary, place slip pins in the top and bottom holes of one flange (see Figure B-2 below).

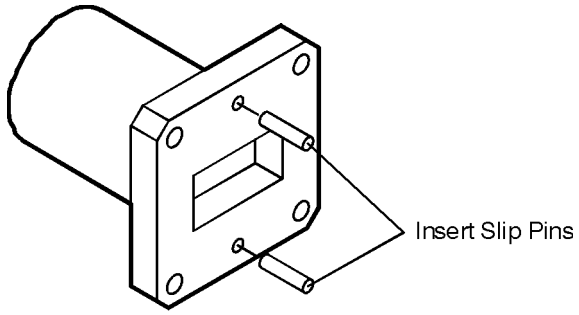

Figure B-2 Inserting Slip Rings

2. Using the pins as guides, carefully align the flanges, and insert screws in two opposite corner holes (see Figure B-3 below).

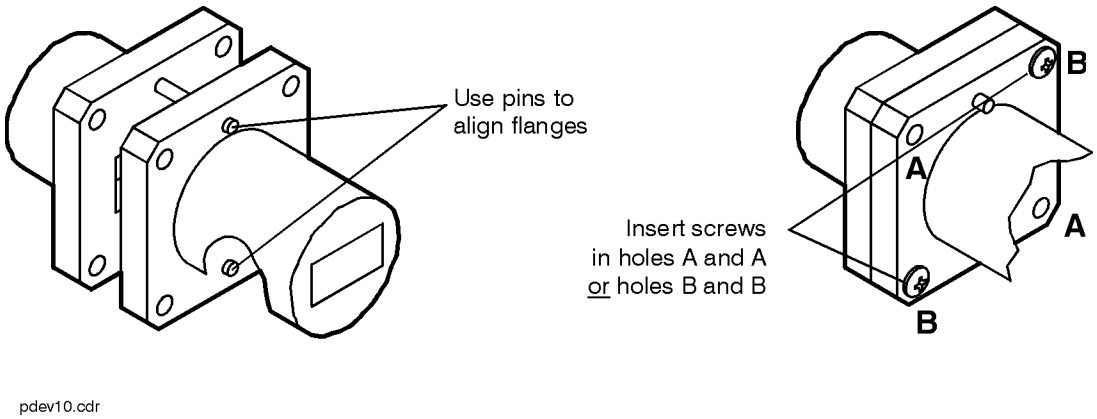

Figure B-3 Align Flanges

3. Place a lock washer and nut on each screw, and finger tighten.
4. Insert the remaining two screws.
5. Place a lock washer and nut on each screw, and finger tighten.
6. If necessary, remove the alignment pins.
7. Go to “Tighten Flange Connections” on page B-4.

Tighten Flange Connections

8. In an X pattern (for equal compression), tighten all four screws (see Figure B-4). Do not over-tighten.
9. Visually inspect the connection.

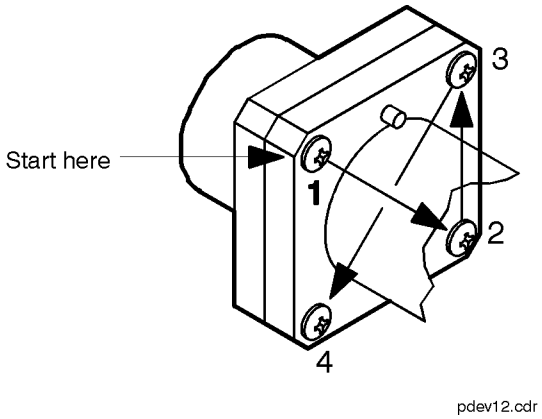

Figure B-4 Inspect Flange Connections

NOTE

The best connection has symmetrical pressure applied as you gradually tighten the screws.

Inspect Flange Connections

Visually inspect a flange connection as follows:

10. Place an electric light or white paper behind the connection.
11. Check the flange matings for any gap. A good connection has no gaps between the connected waveguide flanges, and the waveguide walls are flush (there is no step or offset).
12. Make sure that all four screws are equally torqued.

NOTE

Remember the most common cause of measurement error is a poor connection.

Aligning Precision and Non-Precision Flanges

1. Place an alignment pin (with head) in the corner hole of one flange. Place a second alignment pin in the diagonal corner hole of the second flange (see Figure B-5).

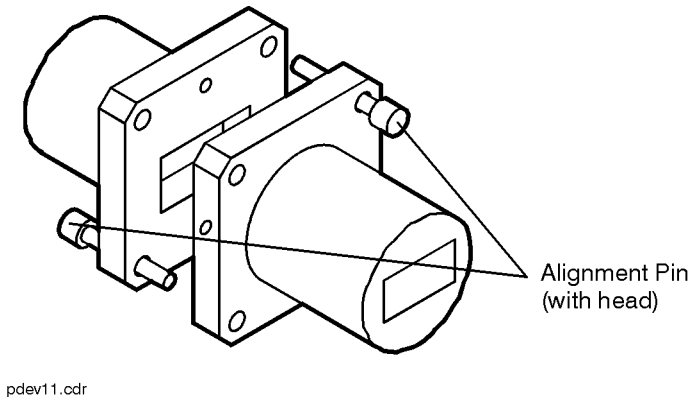

Figure B-5 Align Pin with Head

2. Using the pins as guides, carefully align the flanges, and insert screws in the two open corner holes.
3. Place a lock washer and nut on each screw and finger tighten.
4. Remove the alignment pins and insert the remaining two screws.
5. Place a lock washer and nut on each screw and finger tighten.

Tighten Flange Connections

6. In an X pattern (for equal compression), tighten all four screws (see Figure B-6). *Do not* over-tighten.

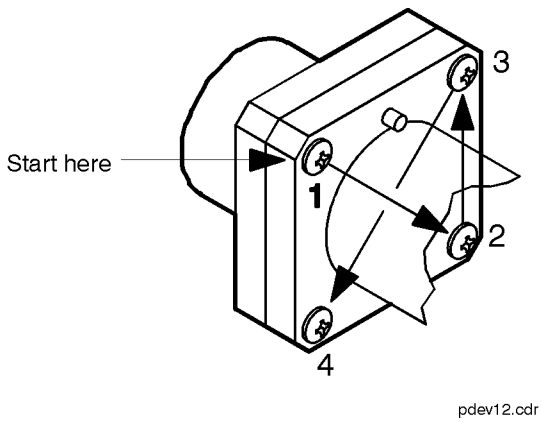

Figure B-6 Tighten Screws

NOTE

The best connection has symmetrical pressure applied as you gradually tighten the screws.

Inspect Flange Connections

Visually inspect a flange connection as follows:

7. Place an electric light or white paper behind the connection.
8. Check the flange matings for any gap. A good connection has no gaps between the connected waveguide flanges, and the waveguide walls are flush (there is no step or offset).
9. Make sure that all four screws are equally torqued.

NOTE

Remember the most common cause of measurement error is a poor connection.

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